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PAPERS AND PROCEEDIN

OF THE

ROYAL SOCIET

OF

TASMANIA,

FOR

1890.

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PRINTED AT "THE MERCURY" OFFICE, MACQUARIE ST., H

1891.

The Responsibility of the Statements and Opinions given in the following Papers and Discussions rests with the individual Authors; the Society as a body merely places them on record.

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ROYAL SOCIETY.

APRIL, 1890.

The inaugural meeting of the members of this Society for the sessi of 1890 was held on April 22nd at the Museum. The President, H Excellency Sir R. G. C. Hamilton, K.C.B., took the chair, and there w a large attendance of Fellows, while the visitors included a number ladies.

PROFESSOR HUXLEY.

The **President**, on taking the chair, said he was not going to depa from his usual custom of only inflicting one address on the Society the close of the session by giving an address also at the opening, bu there was a matter which he would like to see brought before th Council and members of the Society. They had seen from the telegraphic news from London that Professor Huxley was on his way t Australia. He was to stop at Teneriffe and thence go on to the Cape coming on to Australia by one of the Shaw Savill steamers. If tha were so Hobart would be the first point in Australia that Professo Huxley would visit, and he thought that the advent of so great a ma of science ought to receive some recognition from the Society. H therefore suggested to the Council and Fellows that it was very desirabl that on his arrival the Professor should be met with an address from th Society. He would do all he could to induce Professor Huxley to break his journey at Hobart and spend a few days in Tasmania. But even if the Professor was only here during the short time the vessel was in Hobart he still thought they might make arrangements to invite him to the rooms of the Society to receive an address from the Fellows, which he (the President) would be glad to present. (Applause).

Mr. Alexander Durrand, F.R.M.S., was introduced as a visitor.

NEW FELLOWS.

Rev. E. H. T. Thompson, Messrs. A. W. Gosnell, M.A., and Robert Shirley Hales were admitted Fellows of the Society.

ADDITIONS TO LIBRARY.

The Secretary, Mr. A. **Morton**, read the following list of additions to the Library of the Royal Society :—

Adelaide University Calendar for the Academical Year 1890 (bound). From the Council.

Anales de la Oficina Meteorologica Argentina, Tomo VII. From the Department.

Anales del Ministerio de Fomento de la Republica Mexicana. From the Society.

Annales de la Société Royale Malacologique de Belgique. Current Nos. From the Society.

Annual Progress Report of the Geological Survey for the year 1888-9, Queensland. From the Government Geologist.

Anzeirger der Kaiserlichen Akademie der Wissenschaften Mathematisch Naturwissenschaftliche Classe XXV., 1888. From the Society.

Astronomische Arbeiten des K. K. Gradmessungs-Bureau, 1, Band. From the Society.

Athenæum. Current Nos.

Boletin Mensual del Observatoria Meteorologico del Colegio Pio de Villa. Colon Montevideo. From the Society.

Boletin Mensual, Tomo II., No. 34. Mexico. From the Society.

Boletim da Sociedade de Geographia de Lisboa. Current Nos. From the Society.

Bollettino della Societa Geografica Italiana, Serie 3, Vol. II., III., 1889, 1890. From the Society.

Bollettino dei Musei di Zoologia ed Anatomia Comparata, Vol. IV., 1889. From the Society.

Botany Bay, or Eucalyptus "Kino" (pamphlet). By J. H. Maiden, F.L.S. From the Author.

Bulletin of the Museum of Comparative Zoology at Harvard College, Cambridge, Mass., Vol. XVI., No. 6, Geological Series. The intrusive and extrusive Triassic trap sheets of the Connecticut Valley. By W. M. Davies and C. L. Whittle, Vol. XVIII., No. 5. The Morphology of the Cartoids. By F. Ayers, No. 6. Cave Animals from Western Missouri. By S. Garman. Annual Report for 1889. From Professor Agassiz.

Bulletin de la Société Imperiale des Naturalistes de Moscow, current Nos. From the Society.

Bulletin de la Société Royale de Botanique de Belgique Tome Vingt-Huiteme. Bruxelles, 1889.

Catalogue of Fossil Reptilia and Amphibia, part III., 1889. From the Trustees British Museum.

Contributions to Canadian Palæontology, Vol. I., by J. Whiteaves, F.G.S., "On some fossils from the Hamilton formation of Ontario, with a list of the species at present known from that formation and province." The fossils of the Triassic Rocks of British Columbia. On some Cretaceous Fossils from British Columbia, the N.W. Territory, and Manitoba. From the Department.

Department of Agriculture of Victoria, Bulletin June, 1888. Bulletin 3, 4, 5, April, July, and September, 1889. From the Department.

Department of Agriculture, Queensland—Report of the Government scientific expedition to Bellenden—Ker Range upon the Flora and Fauna of that part of the colony. From the Department.

Department of Mines, Sydney, N.S.W. Records of the Geological Survey of N.S.W., Vol. 1; Parts I., II., 111., 1889. Palæontology—No. 1. The invertebrate fauna of the Hawkesbury. Winamatta series, beds above the productive, coal measures of N.S.W. By R. Etheridge, junr. Mineral products of N.S.W. By Harrie Wood. Notes on the Geology of N.S.W. By C. S. Wilkinson. Description of the Seams of Coal worked in N.S.W. By J. Mackenzie. Geology of the Vegetable Creek Tin-Mining Field, New England District, N.S.W., with maps and sections. By T. W. E. David. Contribution to the Tertiary Flora of Australia. By Dr. C. Baron von Ettingshausen. Annual Report of the Department of Mines for the year 1888. From the Department.

Department of Agriculture United States (Division of Entomology). Insect Life. Vol. I., Nos. 1 to 12, 1889, devoted to the Economy and Life Habits of Insects, especially in their relations to agriculture, and edited by the Entomologist and sanction of the Commissioner of Agriculture. Nos. 1 to 6, 1889. Bulletin No. 16. The Entomological Writings of Dr. A. S. Packard. By S. Henshaw. 1887. Bulletin No. 18. The Life and Entomological Work of the late Townend Glover, first Entomologist to U.S. Dept. of Agriculture. By C. R. Dodge. 1887, Bulletin 19. An examination of the published synopsis catalogues and lists of N.A. insects, together with other information intended to assist the student of American Entomology, 1888. Bulletin 20. The Root Knot disease of the peach, orange, and other plants in Florida due to the work of Angullura, prepared under the direction of the Entomologist, J. C. Keal. Bulletin No. 9. The Mulberry Silkworm; being a manual of instructions in silk culture. By C. V. Riley. No. 10. Our Shade Trees and their insect defoliators; being a consideration of the four most injurious species which affect the trees of the capital, with means of destroying them. By C. V. Riley. No. 11. Reports of experiments with various insectide substances, chiefly upon insects affecting garden crops. No. 13. Reports of observations and experiments on the practical work of the division made under the direction of the Entomologist, 187. No 14. Do. do. No. 15. The Icerya or Fluted Scale, otherwise known as the Cottony Cushion Scale. Catalogue of the exhibit of Economic Entomology at the World's Industrial and Cotton Centennial Exhibition, New Orleans, 1884-5. No. 6. General Index and supplement to the nine reports on the insects of Missouri, By C. V. Riley, Washington, 1881. Third report of the U.S. Entomological Commission, relating to the Rocky Mountain Locust, the Western Cricket, the Army worm, Canker worm, the Hessian fly, together with descriptions of Larvæ of injurious forest insects. Studies on the embryological development of the locusts and of other insects, and on the systematic position of the orthoptera in relation to other order of insects. Four reports of the U.S. Entomological Commission; being a revised edition of Bulletin No. 3, and the final report on the Cotton worm, together with a chapter on the Bollworm. By C. V. Riley. Maps and Illustrations. From the Entomoogist.

Encyclopædia Britannica, a dictionary of arts, sciences, and general literature (ninth edition), Vols. 1 to 24, with index. From His Excellency Sir R. G. C. Hamilton, K.C.B.

Estudio de la Filosofia y Riqueza de la Lengua Mexicana par el presb AJastina de la Rosa. From the Department.

Geological and Natural History and Survey of Canada, A. R. C. Selwyn, LL.D., Director. Vol. I., pp. 11. Contributions to Canadian Palæontology. By J. F. Whiteaves, F.G.S. Contributions to the Micro Palæontology of the Cambria silurian rocks of Canada, pt. II. By E. O. Ulrich. From the Department.

Guide to the Mineral Gallery, British Museum. From the Trustees.

Guide to the study of insects and a treaty on those injurious and beneficial to crops, for the use of colleges, farms, and agriculturists, with 15 plates and 670 woodcuts. By A. S. Packard, New York, 1889, (Bound).

Hepatic, A new British. By A. H. Pearson. From the Author.

Illustrations of typical specimens of Lepidoptera, Heterocerca collection in the British Museum, Vol. VIII. By A. G. Butler. Illustrated (bound). From the Trustees.

Jahrbuch des Norwegischen Meteorologischen, Instituts, 1885-6. From the Department.

Journals and proceedings of the Royal Society of New South Wales, Vol. XXIII., 1889, report 1. From the Society.

Journal of Morphology, Vol. III. From the Editor.

Journal of the Royal Microscopical Society. Current Nos. From the Society.

Lichen Flora of Queensland with description of species. By J. Shirley. From the author.

List of named Insects in the South Australian Museum, Adelaide. By J. G. O. Tepper, F.L.S. From the author.

Meteorological Service, Dominion of Canada., Monthly weather Review. Current Nos. From the Department.

Meteorologische Beobachtungen Moscow. From the Department.

Monograph of the Horny Sponges of Australia. By Dr. Lendenfeld. Illustrated (bound). From the Trustees Sydney Museum.

Monthly notices of the Royal Astronomical Society (current numbers). From the Society.

Monthly Weather Review of the United States (current numbers). From the Department.

Monthly records of results of observations in Meteorological, Terrestrial Magnetism, etc., taken at Melbourne during October and March, 1889. From the Department.

Nature. Current Nos.

Nouveaux memoires de la Societe Imperiale des Naturalistes de Moscow, Tome XV. From the Society.

On Lighting and Gundpowder Magazine. On the Theory of Hail (pamphlets). From Mrs. Davies.

Perak Government Gazette. From the Government.

Proces-verbaux de la Seances Societe Royale Malacologique de Belgique. 1888-9. From the Society.

Proceedings of the Canadian Institute, Toronto, October, 1889. From the Society.

Prodromus of the Zoology of Victoria. Decade XIX. From the Government.

Psyche, a journal of Entomology, Comb., Mass. From the Society.

Proceedings of the Linnean Society of New South Wales (second series). Vol. IV. Pts. 1, 2, 3, 4. 1889. From the Society.

Records of the Australian Museum, edited by the Curator, Vol. I., No. 1, March, 1890. From the Department.

Records of the Geological Survey of India, Vol. XXII., pt. 4, 1889. From the Department.

Report of the first meeting of the Australasian Association for the Advancement of Science, held at New South Wales in August and September, 1888 (bound). From the Association.

Report of the Surgeon-General of the Army, U.S., June, 1889. From the Department.

Report of Mr. Tebutt's Observatory, N.S.W., for the year 1889. By J. Tebutt. From the Author.

Revue des Deus mondes, December 1, 1889. From the Society.

Revista do Observatorio Publico Mensal Imperial do Observatorio do Rio de Janciro, Amion IV., 1889. From the Society.

Scottish Geographical Magazine, current Nos. From the Society.

Societé de Géographie de Lisbonne L'Incident. Anglo-Portugais motion Votée a la Seance de la Sociète de Geographie de Lisbonne. Le 2 Decembre, 1889. Impotation abusive en Afrique par des subjets Anglais D'Armes Perfectionne. From the Society.

Statistics of the Colony of Tasmania for the year 1888. From the Government.

Transactions and Proceedings and Report of the Royal Societv South Australia. Vol. XII., for 1888-9. From the Society.

Transactions of the Geological Society of Australasia. Vol. 1, IV. From the Society.

Transactions of the Royal Society of Canada for the year 1888. Vol. VI. From the Society.

Transactions of the Wagner'Free Institute of Science of Philadelphia. Vol. 2. From the Soceity.

United States Coast and Geodetic Survey Report of the Superintendent, showing the progress of the work during the fiscal year ending with June, 1887. Part I., Texts ; Part II., Sketches. From the Department.

Verhandlungen der Gesellschaft Fur Erdkunde [zu Berlin. Band XVI., XVII., No. 9. From the Society.

Victorian Year Book for 1888-9, Vol. I. From the Government Statist.

Victorian Naturalist, The. Current Nos. From the Society.

Walch's Catalogue of Books for 1890. From the Publishers.

Sir Lambert Dobson thought that they could hardly allow the list of additions to pass without calling special attention to the valuable addition made to the library by the presentation of the ninth edition of the "Encyclopædia Britannica" by His Excellency. This was a very grand and noble work, a veritable storehouse of knowledge, and treating of almost every possible subject in articles supplied by the greatest specialists of the day. He would not move a formal vote of thanks, as His Excellency was in the chair, but he was sure he spoke the unanimous feeling of the Society when he said that they all cordially appreciated the gift of His Excellency. (Applause.)

His Excellency, who was received with applause, said that the discovery of the existence of a Royal Society in vigorous operation was one of the many pleasant surprises he met in coming to Tasmania, and he made up his mind to do all he could to advance its objects, and as time went on to mark his appreciation of the work of the Society in a tangible and useful way. He had himself found in considering some of the subjects brought forward by the Society the want of ready access to some comprehensive and authoritative work of reference, and it seemed to him that the want must be felt by others. He therefore determined to present the Society with the best and most comprehensive work of reference, and it gave him much gratification to find that the addition to the library had met with acceptance. (Applause.)

AUSTRALASIAN ASSOCIATION.

Mr. **James Barnard**, Vice-President of the Society, said: Following the course which I took on the occasion of my return from attending the first meeting of the Australasian Association for the Advancement of Science, which was held in Sydney in 1888, when I gave a short personal explanation of what had occurred, I now ask permission to state in a few words the particulars of the second annual meeting of the Association, which was held in Melbourne in January last. As is known to the Fellows, several other gentlemen representing our Royal Society were associated with me in this visit to Melbourne, and I venture to in some measure speak their sentiments as well as my own when I bear testimony to the warmth and cordiality of the welcome accorded to us in Melbourne from the moment of our arrival until our departure. Throughout our stay we were most hospitably entertained with free quarters by Dr. Leeper at Trinity College in the University, besides sharing in a variety of entertainments and concerts given generally to the members of the Association by the distinguished President, Baron Von Mueller, K.C.B., the Hon. Sir William Clarke, Bart., the Worshipful the Mayor of Melbourne and others. Excursions and visits to places of attraction were also planned and provided for, and were more or less availed of. I need not speak of the part which my colleagues and myself took in the work of the several sections of the Association, as that will be shown in the annual volume recording its transactions. Suffice it to say that the sittings of the various sections were assiduously attended by our little Tasmanian band. During the session Tasmania came well to the front, and the proposal to hold the fourth annual meeting of the Association at Hobart in 1892, instead of at Adelaide, received general support, and was carried by acclamation. Hence it is suggested that a corresponding obligation is now imposed upon the Council and Fellows of the Royal Society of Tasmania, aided by the willing co-operation of all having sympathy with the object, to form themselves into a committee to consider the proper steps to be taken for holding the meeting of the Association in Hobart at the date fixed; nor is it much too soon to open a subscription-list and invite for it liberal support; for while it is neither expected nor desired that Tasmania, with its limited means, should attempt to vie with Melbourne or Sydney, with their magnificent resources, still the expenses incidental to the honour of the position, and the call to reciprocate in some degree the attentions shown to the Tasmanian representatives in the colonies mentioned, must necessarily be considerable. It may also be mentioned, in conclusion, as a good omen of success, that our painstaking and energetic secretary, Mr. Alexander Morton, has accepted the position of local honorary secretary for the occasion; and a general desire was expressed that our own highly-esteemed president, His Excellency Sir Robert Hamilton, would consent to officiate as president of the Association for its meeting in Hobart in 1892. (Applause).

THE SETTLEMENT OF NORTHERN TASMANIA.

Mr. J. B. **Walker** read a paper on "The Discovery and Occupation of Port Dalrymple." The writer began by remarking that the discovery of Southern Tasmania belonged to the ancient epoch of Australian history, but the discovery of Northern Tasmania to the modern period 150 years later, when Port Jackson had already been settled. The exploration of Bass Straits and of Port Dalrymple was the work of Bass and Flinders. A sketch of the daring voyage of Bass from Sydney to Western Port in an open boat, and of the discovery of Port Dalrymple and circumnavigation of Tasmania by Flinders and Bass in the little 25-ton sloop Norfolk in 1798, followed. The northern settlement was made by order of Lord Hobart, Secretary of State for the Colonies, for political reasons, to prevent the French getting a footing in Bass Straits. Colonel Paterson was appointed Lieut.-Governor of the New Settlement, and left Port Jackson on June 7, 1804, with 20 convicts and a guard of 20 soldiers. The ships were driven back by gales, but in October following a new attempt was made, and this time was successful. H.M.S. Buffalo, assisted by the schooners Integrity and Francis, and the armed tender Lady Nelson conveyed the expedition, which consisted of 67 military, under the command of Capt. Anthony Fenn Kemp and 74 convicts. Dr. Mountgarrett was surgeon, and Mr. Alex. Reilly storekeeper. The vessels were separated by a gale on the voyage down, and the Buffalo on entering the River Tamar ran aground near Outer Cove (George Town). The prisoners and stores were accordingly landed there on November 10, 1804, and formal possession was taken the next day. Huts were erected at Outer Cove, and the settlement established there, while Lieut. Governor Paterson went up the river to examine the country. He went up the North Esk some miles in his boat, and considered the country better than any that had been up to that time discovered, either in Van Diemen's Land or New South Wales. On his return, however, he chose, as his headquarters, a site at the head of the shallow inlet of Western Arm where the land was bad. Mr. Walker thought that Paterson's reasons for what seemed such an extraordinary choice were to be sought in the policy of the Home Government whose object was to establish military posts near the entrances of harbours to be maintained by convict labour, and not to found colonies in the modern sense. In March 1805, Paterson moved his headquarters to the new site, which he named York Town, but still retained the settlement at Outer Cove (George Town.) At this time the colony contained about 200 people, afterwards increased to 300. After about 12 months York Town was found so unsuitable that Paterson in March 1806, removed his headquarters to the banks of the North Esk, on the present site of Launceston. York Town was not finally abandoned until a year later. The site of this early settlement is about five miles north-west of Beaconsfield, at the head of Western Arm, nearly opposite to George Town. No remains exist of the buildings erected by Lieut-Governor Paterson in 1804.

A GANOID FISH.

The next paper, which was read by Mr. R. M. Johnston, was a description by that gentleman in conjunction with Mr. A. Morton, of a second ganoid fish from the lower mesozoic sandstones, near Tinder-Box Bay. Last session the same gentlemen brought under the notice of the Society a similar fish, obtained from the Knocklofty sandstones, and named *Acrolepis Hamiltoni*, in honour of the President, Sir Robert Hamilton. The present specimen is much better preserved, and although closely allied to the first is yet distinct in several respects. Some good photographs of the specimen were shown, and the writers expressed their belief that there was a probability of a larger number of these interesting fish remains being obtained when operations in certain quarries were again carried out. He mentioned as an interesting fact that a fish of similar species had been recently found at Latrobe.

MARINE ORGANISMS.

Mr. A. Durrand, Fellow of the Royal Microscopical Society, London, exhibited a select series of microscopical preparations of foraminifera and other minute marine organisms from soundings made at depths from five fathoms to about two miles among the islands of the Hawaiian Group, Coast of Java, Channel Islands (Guernsey), Ireland, etc., demonstrating the important part which the calcareous and siliceous remains of these organisms play in submarine deposits, which after upheaval and solidification, constitute a material portion of limestone and similar formations, the city of Richmond, United States, America, being built on an ancient sea bed covering a considerable area, many feet in depth, and largely composed of the inorganic remains of these tiny denizens of the deep, the beauty of which is indescribable by pen or pencil. Some of the specimens shown were from a fossil deposit over 60ft. thick at Wanganui, New Zealand, and appeared as perfect as those recently alive. In connection with this he stated that Mr. Morton, Secretary of the Society, and he (Mr. Durrand), purposed conducting dredging operations in the harbour to ascertain the distribution of these interesting forms, the result of which will probably be submitted to the Society during his stay, and as the microscopical life of our harbour may present some unique features, being yet comparatively unexplored, the investigations of Messrs. Morton and Durrand are expected to result in important information in this direction.

CONGRATULATORY.

The President moved a vote of thanks to the gentlemen who had contributed papers, and mentioned as a matter for congratulation that for the first time the printed proceedings of the past session were on the table at the opening of a new session.

The proceedings terminated.

MAY, 1890.

The monthly meeting of this Society was held at the Museum on Tuesday, May 20th, the President, His Excellency Sir Robert G. C. Hamilton, K.C.B., took the chair.

NEW MEMBERS.

The following gentlemen were elected Fellows:—Messrs. A. B. Howell, J. W. Beattie, Alfred T. Bell, and H. Foster.

THE LIBRARY.

The Secretary, Mr. A. MORTON, submitted the following list of additions to the Library during the month of April:—

Bollettino della Societa Geografica Italiana, Fasciolo II., February and March, 1890. From the Society.

Boletin Mensual del Observatorio, Meteorológico del Colegio Pio de Villa Colon. From the Department.

Boletin del Instituto Geografica Argentino, Tomo X Cuad X Bueno Aires. From the Society.

Flora of British India. Pt. XVI. By Sir J. D. Hooker. From the Department.

Geological and Natural History Survey of Canada, Alfred R. C. Selwyn, C.M.G., etc., Director. Annual Reports (new series). Vol. III., pt. I. Reports, A.B.C.D.E.F., 1887-8, pt. II. Reports, H.J.K.L.M.N.R.S.T., 1887-8. Maps, etc., to accompany Annual Reports, Vol. III., 1887-8. From the Department.

Handbook of cyclone storms in the Bay of Bengal, for the use of sailors. By J. Eliot, M.A. From the Meteorlogical Department.

Horsburgh's East India Pilot, containing a number of old Charts, London 1817, also Table des Cartes et Plans, contenus dans L'Atlas du voyage aux Terres Australis, 1801 to 1808. From the Hon. Attorney General.

Journal of the Royal Horticultural Society of London, Vol. XI., part III., October, 1888. From the Society.

Kongl. Svenska Velenskaps—Akademiens Handlingar Bandet 23, No. 3. Species Sargassorum Australiæ, Descriptœ et Dispositæ accedunt de Singulis Partibus. Sargassorum Earumque Differentüs Morphologicis in diversis speciebus observationes nonnullæ, nec non dispositionis specierum omnium generis his differentüs Fundatœ, Periculum, Auctore J. G. Agardh, cum XXXI., Tabulis. From the Society.

Memoirs of the Museum of Comparative Zoology, Cambridge, Mass. Vol. XVII. No. 1. The immature state of the Odonata. Pt. III. Sub-family Cordulina. By Louis Cabot. (Plates.) From A. Agassiz.

Memoirs of the Geological Survey of India, Palæontologica Indica, being figures and descriptions of the organic remains procured during the progress of the Geological Survey of India. Ser. XIII. Salt Range Fossils. Vol. IV., pt. I. Geological Results. By W. Waagen, Ph. D. From the Department.

Monthly Weather Review, Meteorological Service Dominion of Canada. (Current Nos.) From the Department.

Monthly Weather Review, U.S. War Department. (Current Nos.) From the Department.

Monthly notices of the Royal Astronomical Society, Vol. L., No. 4, February, 1890. From the Society.

Report on the worm disease affecting the oysters on the coast of N.S.W., by T. Whitelegge, F.R.M.S., April, 1890. From the Fisheries Department.

Revista do Observatorio Publicacao mensal de Observatorio do Rio de Janeiro, Anno V., Jan. de 1890, N. 1. From the Department.

Scottish Geographical Magazine, current Nos. From the Society.

United States Department of Agriculture (Division of Entomology), Vol. ii., Nos. 7, 8 and 9. Insect Life. January, February, March, 1890. Bulletin No. 21, Report of a trip to Australia, made under the direction of the Entomologist to investigate the natural enemies of the Fluted scale, by Albert Koebele. From the Department.

Victorian Year Book for 1888-89. From the Government Statist.

Tasmanian Official Record, 1889. By R. M. Johnston, F.R.S. From the author.

Transactions of the Royal Society of Victoria. Vol 1, Pt. ii. From the Society.

Transactions of the Seismological Society of Japan. Vol. xiv. From the Society.

THE LATE REV. J. E TENISON-WOODS.

Mr. R. M. JOHNSTON referred to a proposal to erect a memorial tombstone over the grave of the late Rev. J. E. Tenison-Woods, as a small tribute of respect to one who has done much for the good of religion and science, and also for the colonists generally, in whose interest he sacrificed his valuable life. He said he had been associated with the deceased for many years, and derived the greatest benefit from him in many branches of science. He was in sympathy with all fellow-workers throughout the Australias, and it was hoped the object would be successful. He placed a subscription list on the table in order that members who desired might contribute.

TASMANIAN FISHES.

Mr. R. M. JOHNSTON, F.L.S., read a paper, entitled, "Further observations upon the fishes and fishing industries of Tasmania, together with a revised list of indigenous species." Eight years ago he contributed a similar paper, and since that time Messrs. Alex. Morton and Saville Kent have added two or three interesting papers on the same subject. By this means the 188 species then known have increased to 214. After giving a complete list of the fishes Mr. Johnston dealt with the fishing industry, estimating that there are about 86 boats and 175 men engaged therein. Although it is estimated that, exclusive of the whaling trade, there are 1,005 persons directly depending upon the local fisheries, fully 63 per cent. of the men and boats belong to Hobart, and the men carry on their vocation either in the numerous sheltered indentations or bays in the upper or lower waters of the estuary of the Derwent, or in the exposed open sea between Seymour on the north-east and Port Davey on the south-west. The fishing carried on elsewhere, with the exception of the purely river fishing of the Tamar, is very limited, generally engaged in at odd times by persons who do not devote themselves exclusively to the fishing industry. The Tamar boats are not suited for fishing in the open sea of Bass Straits. With the exception of three or four decked smacks, the most of the boats employed in the waters of the Derwent, or in the open sea trumpeter and Barracouta fishing-grounds, are mere open centre-board whaleboats, fitted with fish-wells perforated in direct communication with the sea, and designed to keep the fish alive until sold in the open market in the Fisherman's Dock, Hobart (salt water.) The trumpeter and other fish will feed in such confinement, and the former has been known to live healthily in this way for a period of three months. The average value of one of these excellent sea-boats is (generally about 37ft. 6in. long; beam, 7ft. 8in.; depth, about 3ft.) about £100, and the equipment, in the shape of nets and deep sea lines, say £20; in all, say £120 for each boat. There are usually three men to each boat. Even with a small crew of this kind, as much as 40 dozen kingfish, weighing 12 to 14lb. each, have been caught in a single night when the fish have been plentiful. Barracouta can be captured in large quantities during the season—January to June. About 24 dozen Barracouta weigh a ton. The fishermen state that, could they be assured of a market, 3s. a dozen for barracouta or kingfish would amply repay them—*i.e.*, about ¼d. a pound. The average quantity of trumpeter, perch, trevally, barracouta, kingfish, conger eel, and crayfish, exported each year, almost wholly to Victoria, amounts to 3,396doz. The average price of the trumpeter is fixed at 1s. per lb., and he estimates that the yearly sales of fish since the decline of the oyster fishery do not exceed £10,000 per annum. The decline in the value of oil obtained from the whale fishery is shown by comparing the first and second quinquennium, the first yielding £31,281 worth, and the second £19,223 worth.

ROOT MATTERS IN SOCIAL AND ECONOMIC PROBLEMS.

Mr. R. M. JOHNSTON, F.L.S., continued his study of root matters in social and economic problems by reading a paper on that head. This contribution formed the second series, and follows the able paper read by him during last session. In that he dealt exhaustively with almost every branch of social and economic science, and in the paper read last night he treated the same subjects under the following heads:—"Natural Limits to the numbers engaged in various occupations;" "Dominating wants determine occupations, and necessarily produce inequalities in the form of services;" "Utopian scheme of socialists;" "What should be the probable effect upon social well-being if the major source of savings were destroyed;" "Anterior savings the true source of capital invested in the creation and distribution of necessary satisfactions;" "Fallacies of the single tax proposal." To give a clear example of the difficulties that are here to be met with by workers he introduces a fictitious deputation from the shoemakers driven out of employment by competition with cheap foreign manufactures, and employs a theorist to represent the Government and argue the question with him.

Mr. A. J. TAYLOR thought that one of the principal values of the papers read by Mr. Johnston consisted in the fact that they drew attention very positively to the fact that in writing and dilating upon the social problems occupying our attention we were apt to lose sight of the deeper considerations that underlie the superficial consideration often given to those questions. Mr. Johnston gave an illustration of this in his last paper, when in speaking of protection and freetrade, he called attention to the fact that we were apt, in dealing with the subject, to regard those important questions as ends rather than as means to an end, that end being to secure the maximum of comfort essential to living a healthy and happy life at a minimum cost of labour. He referred briefly to several of the subjects alluded to in the paper, and considered such contributions valuable, as showing the people that many economic questions have not yet been settled, and have still to be faced.

His EXCELLENCY said:—"A paper like that read to us to-night by Mr. Johnston requires to be studied carefully before discussing it, and I do not wish to enter into discussion with Mr. Johnston, for although some of the propositions he has raised are in their essence rather economic than political, yet the question of protection of native industries has, in these colonies, a political and party bearing which makes it undesirable that I, as Governor, should take part in discussing them. But there is one root matter in connection with economic problems bearing directly upon this point to which I do not think Mr. Johnston has sufficiently called attention, and it is this, that all commerce is barter, and that if we import foreign goods, either shoes or anything else, we export something in exchange for them, and if we cease to import such goods, we necessarily interfere with the production of the native goods which we exported to pay for them. I do not for a moment suppose that Mr. Johnston would dispute this root matter, and I am sure he will not feel annoyed at my pointing out that in my view it deserves more attention at his hands than it has received in this paper." He moved a vote of thanks to Mr. Johnston for his papers, which was passed.

HOP PLANT.

Mr. ALFRED J. TAYLOR called attention to a specimen of the native hop (*Daviesa latifolia*). This shrub was to be found on all the stony ridges and barren bush lands of the colony. He had been assured that some remarkable cures of hydatids had been effected in Victoria by the administration of an infusion made from the leaves of this plant. Perhaps the Government Analyst would kindly prepare some notes on the plant for some future meeting of the Society. He also showed two interesting illustrations of homes made without hands in peculiar formations of gum leaves.

FORAMINIFERA AND MOLLUSCA.

Mr. MORTON drew attention to a recent dredging trip in the harbour, and regretted that Mr. Durrand, who was introduced at the last meeting, was unable to be present to submit a microscopical slide containing some very interesting examples of various forms of foraminifera that he had mounted for the inspection of the Fellows. The result of the dredging trip was of importance, as the forms obtained resembled the marine fauna of Port Jackson, and the results of a few dredging trips intended during the season would no doubt prove very interesting. Among the specimens dredged were a large number of mussels, and each contained a small crab, which on examination appeared to belong to the genus Fabia. It was rather interesting to learn from some of the old residents that many years back, when mussels were numerous as at present, in the majority of cases every mussel contained a crab similar to those exhibited, and that the oysters, while mussels were in large quantities, were few. Some time afterwards the mussel became nearly extinct, while the oyster multiplied. Whether that was due to this parasitical crab or not he was unable to say, but the fact was singular that while the crab was now noticeable in the mussel the oyster was increasing in numbers. Whether history would repeat itself it would be difficult to say, but it would be interesting to observe the result. In conjunction with Mr. Durrand he intended at next meeting to submit a paper on the results of the dredging of the harbour.

Sir LAMBERT DOBSON recollected that many years ago, when mussels were plentiful, they were destroyed by a little red crab. For many years there were no mussels, now they were again plentiful.

Mr. R. M. JOHNSTON said he had noticed as a remarkable coincidence that the disappearance of the mussel in former years was followed by the increase of the oyster, and the decrease of the oyster meant the increase of the mussel. It was desirable to know the cause of this phenomenon, and he hoped Mr. Morton would pursue his investigations in regard to those molluscs and their enemies.

Mr. MORTON said that he had had forwarded to him, by the Fisheries Commission of New South Wales, a most valuable paper prepared by Mr. Thos. Whitelegge, F.R.M.S., Zoologist to the Sydney Museum, on the disease observed in the oysters on the New South Wales coast. As the question of introducing the Sydney oyster on the Tasmanian coast occupied the attention of the Fisheries Board at present, he intended to submit some extracts from Mr. Whitelegge's valuable paper at next meeting of the Society.

The PRESIDENT moved a vote of thanks to Mr. Johnston for his valuable papers.

The proceedings then terminated.

JUNE, 1890.

The monthly meeting of the Royal Society was held on Wednesday, June 11th, at the Museum. The President, His Excellency Sir R. G. C. Hamilton, K.C.B., took the chair.

NEW MEMBER.

Mr. M. W. Simmons, solicitor, was elected a Fellow of the Society.

RECORDS OF EARLY EVENTS.

Mr. MORTON read a letter from Mr. A. B. Biggs, Launceston, suggesting that something be done by the Society in collecting records of early events in the history of the colony from the few surviving old colonists, as they were rapidly passing to the majority, and the opportunity would soon be for ever lost. The letter was referred to the consideration of Mr. J. B. Walker, who is interesting himself in the ancient history of the colony.

AUSTRALASIAN SCIENCE ASSOCIATION.

Mr. MORTON submitted programme of the third annual meeting of the Australasian Association for the Advancement of Science, which will commence on Thursday, January 15, 1891, at Christchurch, New Zealand.

His EXCELLENCY asked if any of the members of the Society were going take to part in the proceedings.

Mr. MORTON said he believed that several members had forwarded their names to New Zealand.

THE MOON AND THE RAINFALL.

Mr. E. C. NOWELL, hon. member Royal Statistical Society, read a paper entitled "Do the changes of the moon affect the rainfall?" He said that the idea that the changes of the moon affected the rainfall had widely prevailed from the earliest ages. Traces of it were found in the Roman poet Virgil, while ages before the Babylonian Government Astronomers in their daily reports inserted many entries respecting the supposed influence of the heavenly bodies on the weather. Sailors especially were great believers in the influence of the moon on the weather, and the writer believed that it would be found that where ideas have become deeply rooted and widely spread, it is very seldom, if ever, that they have not some foundation in fact. The public, however, were assured by those whose opinions on such subjects carry great weight, that the popular notion was a mere delusion, and that the moon's changes had no influence on the weather. He quoted as scientific authorities on this point, Dr. R. J. Mann, vice-president of the Meteorological Society, Dr. Lardner, and Dr. Ball, Royal Astronomer of Ireland. Seeing that the statements of scientific men were at variance with the popular opinion, he resolved to investigate the matter for himself, and accordingly in 1880 he commenced to keep a meteorological journal in a rough way, and had continued it up to the present time. The results of the 10 years' observations were set forth in tabulated form, and so far as the inquiries on the subject warranted a conclusion, the only thing that could with safety be asserted was, "That there is a greater probability of having rain on the first than on any succeeding day of any of the moon's changes. He hoped the results submitted would be of some value as a contribution towards the investigation of an obscure but highly interesting subject, and also in stimulating further researches in this direction, in order to discover, if possible, what are the exact nature and limits of the influence exerted upon the earth and its inhabitants by the moon and the remoter planets—the lesser forces—as well as by the great central source of power—the sun itself.

Captain **Shortt** read a brief paper, criticising Mr. Nowell's views, in which he contended that it was not to the moon's influence alone that they should look for the effect stated, although he admitted that the moon was a great factor in the case. Though all parts of the world were not affected alike by the aspect of the sun, moon, and planets, he found that at Hobart under Jupiter and Mars' influence the temperature increased, and decreased with Saturn's; likewise the aspect of Saturn, Uranus, Venus, and Mercury produced rain and low temperature; also, that the aspect of the different planets produced more or less changes in the weather. It was also noticeable that after the tide turned to rise rain set in or fell heavier in rainy weather. Mr. Nowell, in his paper, had only notified the commencement of rain, and did not give the number of rainy days in each quarter. He submitted a calculation of rainy days for 1889, omitting those under three points, which showed that the greatest number of rainy days was on the fourth or middle day of the quarter. The results were set out in tabulated form, and showed that there were 61 days of one or two points of rain. This large number of rainfall he considered attributable to the proximity of the city to Mount Wellington, which attracted the low moist clouds, from which fell slight showers of rain.

Mr. C. H. **Grant** thought it would be interesting to the Society and science generally if Capt. Shortt would give some detailed particulars of the way in which he arrived at the conclusions he had stated in regard to the planets affecting the weather, as those conclusions were not generally known or accepted. He would like also to remark, in regard to Mr. Nowell's paper, that the writer did not profess to be a scientist, and therefore his conclusions were not to be judged by the rigid rules of science. It seemed to him that he had amalgamated to a certain extent popular ideas with science, and that therefore all his conclusions must not be accepted as absolutely proved truths. In regard to lunatics for example, science had proved that there was not that affinity of the one with the other that he had indicated. They were indebted to Mr. Nowell for the trouble he had taken, and he hoped it would lead to the changes in the weather being more carefully noted. The near proximity of the city to Mount Wellington, he believed, affected the rainfall, and consequently he thought that the meteorological tables of Hobart could be said to have very little value as compared with parts of the colony less affected by the proximity of the Mountain.

Capt. **Shortt** promised to read a paper on the influence of the planets on the weather before the end of the session. (Hear, hear.)

Mr. **Nowell**, in reply, said it was impossible for him to deal fully with Captain Shortt's criticisms without having an opportunity to peruse his paper, but if the paper read had done nothing else, it had brought out a most interesting statement from Captain Shortt, and the promise of an interesting paper. Captain Shortt had conducted his observations on a different system, but until he had a further opportunity of studying the matter he must adhere to his own system. Mr. Grant was inclined to think that the influence of the moon on lunatics was one of the popular ideas, but he thought it had been pretty well established by the officers of lunatic establishments, and might now be regarded not as one of the popular ideas, but as a scientific fact. Of course, as Mr. Grant said, he did not profess to be a scientist, but had rather treated the subject from a statistical point of view. They did not profess to be ultimate conclusions, but merely such as the facts seemed to warrant, and he would be glad if his paper was the means of causing the matter to be more accurately investigated. In regard to the situation of Hobart and its proximity to the Mountain, he had guarded himself on this point by explaining that the observations were only intended to apply to Hobart, but he might say that Mr. Shoobridge told him that the rainfall at New Norfolk differed but slightly from that of Hobart, and suggested that he (Mr. Nowell) should take his observations. He considered, however, that he had better confine himself to Hobart, but never for an instant suggested that the conclusions derived from observations at Hobart would be generally applicable throughout the colony.

A FOSSIL TREE.

Mr. JAMES BARNARD read the following notes on a fossil tree found beneath 100ft. of basalt, at Richmond, Victoria, by S. H Wintle:—"In the early part of March last I received information to the effect that a fossil tree, 30ft. in length, had been brought to light by the workmen employed in the "bluestone" quarry of Messrs. Willis Brothers, at Richmond, Victoria. I immediately visited the spot, and found the bole of a tree lying in an east and west direction, partly embedded in a deposit of dark coloured sand. Portions of the trunk were in contact with the base of a basaltic flow 100ft. in thickness by measurement. The general opinion, before I examined it, among the uninitiated connected with the quarry, was that it was the common red gum of Victoria, *Eucalyptus rostrata*. I at once recognised it as belonging to an entirely different order, and if not a pine not very widely removed from it. Up to the present time, however, it has not been determined. I may, perhaps, venture to observe that in it I can see a close resemblance to *Salisburia* sp. (Mueller), which in several instances has been brought to light from under the basalt of the "deep leads" of Ballarat and elsewhere in Victoria. The tree is denuded of its branches; short stumps alone being left. This fact, coupled with the absence of twigs, leaf impressions, and seed vessels, and also the fine uniform character of the sand deposit, points to the tree having been carried to where it was found by aqueous drift agency. Although I requested the proprietors of the quarry to instruct their workmen to preserve anything in the vicinity of the tree which in the least might resemble nuts or cones, nothing in the shape of fossil fruit has been brought to light. I have been promised, however, that efforts will be made to disentomb the whole tree. The cracks and fissures of the ligneous tree are coated with minute iron pyrites; while the sand on which the tree immediately reposes is cemented to a considerable extent by the presence of the same mineral. For a depth of 4ft. from the base of the superimposed basalt, the deposit on which the tree rests may be described as an imperfect dirt bed, being charged with carbonaceous matter in a fine state of division. A well has been sunk in the compacted sand to a depth of several feet in order to catch the drainage from the joints and fissures in the basalt, but no rounded pebbles or gravel have been met with; nothing, in short, but fine drift sand, thus pointing to a depression that was filled up to a considerable extent by sand transported by aqueous agency prior to the outburst and overflow of the basaltic lava. The southern wall of the quarry is only 50yds., lineally, from the Yarra River. On the opposite bank the highly inclined Upper Silurian shales obtain, forming a precipitous bank in contradiction to a more or less gradually shelving bank wherever the basalt obtains. As the source of this newer pleistocene basalt had its origin, it is generally believed, at Heidelberg, some 10 miles distant, there is good ground for assuming that the Yarra River had not an existence at the period when the basaltic flow formed a crypt to the tree and sand bed; but that at a subsequent epoch it carved out its present channel, chiefly along the line formed by the contact of the basalt with the Silurian strata. It will be observed that the condition of the wood is that of more recent lignite, the fibres being very tough. I am strongly reminded by the occurrence of this tree beneath the basalt, and the physical change which has taken place since it was deposited on its sandy bed, as well as by the existence of the Yarra River, of a similar change at a similar period at the site of the Geilston Bay freshwater limestone at Richmond, in Tasmania. A quarter of a century ago I published a popular description, under the title of "A Story of a Stone," of the great geological changes which had taken place since the traverting beds had been laid down by the eruption of basalt, and the subsequent formation of the River Derwent. The relation that the Yarra River bears to the fossil tree, its sand bed, and superimposed basaltic covering, is precisely the same as that which the Derwent River bears to the fossiliferous travertine deposits." Mr. Barnard added that similar specimens had been presented to the Tasmanian Museum by his son, Dr. Barnard, while in New South Wales.

Mr. Morton expressed regret at the absence of Mr. R. M. Johnston, owing to indisposition, as that gentleman was well acquainted with the subject, having largely referred to it in his "Geology of Tasmania."

Mr. C. H. Grant said that the grain of the wood and general appearance of the specimens showed that the dioritic formation that poured out upon the trunk of the tree was at a lower temperature than was generally supposed.

SPECIMENS.

Mr. T. B. Moore exhibited specimens of Eucalyptus, a variety of Risdoni, and a garnet stone from Collingwood Valley, West Coast.

Mr. Morton exhibited two parrots, presented by Mr. F. Back, General Manager of the Government Railways. They are the Kea (*Nestor notabilis*), natives of New Zealand, and very destructive to sheep.

Mr. Curzon Allport exhibited a specimen of black marble, taken from the mouth of the Gordon River, West Coast. Samples had been sent to London, and a company formed to work the same.

Mr. Morton submitted specimens of ferns connected with limestone formations taken from the Chudleigh Caves.

On the motion of His Excellency, votes of thanks were passed to the gentlemen who contributed papers.

The proceedings terminated.

JULY, 1890.

The monthly meeting of the Royal Society was held at the Museum on Monday evening, July 14th. The President, His Excellency Sir R. G. C. Hamilton, K.C.B., presided.

NEW MEMBER.

Mr. Alexander Montgomery was elected a Fellow.

LIST OF ADDITIONS TO THE LIBRARY.

The following list of additions to the Royal Society's Library during the month of June were read:—

Acta Horti Petropolitani Tomus XI. Fascinlus 1.—From the Society.

Annual Report of the Department of Mines, New South Wales, for the year 1889.—From the Department.

Archives du Musée Teyler, Serie II., Vol. II., 1886; Vol. III., 1887; Serie II., Vol. III., 1889.—From the Department.

Boletin Mensual del Observatorio Meteorologico del Colegio Pio de Villa Colon, Montevideo. From the Society.

Bollettino della Societa Geografica Italiana. Serie III., Vol. III. Fasc. III. Mazo, 1890. From the Society.

Boletino del Instituto Geografico Argentino. Tomo X., Cuarderno X., XI., XII., Buenos Ayres. From the Society.

Boletino Mensual, Tomo II., No. 5, Mexico. From the Department.

Bulletin of the Museum of Comparative Zoology at Harvard College, Cambridge, U.S.A. Vol. XVI., No. 7. The Topography of Florida, by N. S. Shaler. No 8. On some occurrences of Ottrelite and Ilmenite Schist in New England, by J. E. Wolff. Vol. XIX., No. 1. Studies on Lepidosteus, part I., by E. L. Mark. No. 2. On the egg membranes and Micropyle of some Osseous fishes, by C. H. Eigenmann. No. 3. Reports on the results of dredging under the supervision of Alexander Agassiz in the Gulf of Mexico, 1877-8, etc. XXXII. Report on the Nudibranchs, by Rud. Bergh. From the Department.

Californian State Mining Bureau, Ninth Annual Report of the State Mineralogist for the year ending December 1, 1889.—From the Department.

Cyclone Memoirs Part II, Bay of Bengal Cyclone of August 21, 28, 1888.—From the Department.

Fondati on Teyler, Catalogue de la Bibliothéque, dressé par C. Ekama, Cinquieme, Livraison, Paleontologie, Geologie, Mineralogic Botanique, Zoologie, Géographiè, Costumes, Voyages pittoresques et Scientifiques.—From the Department.

Journal of the Royal Microscopical Society. Part 2, 1890. From the Society.

Los Aguas Minerales de Chile por el. Dr. L. Darapsky, Valparaiso. From the Society.

Monthly Record of Meteorological Observations for Victoria. From the Department.

Monthly Weather Review, Canada (current Nos.). From the Department.

Monthly Notices of the Royal Astronomical Society (current Nos.) From the Society.

Observatorio Nacional Argentino, vol. XI. Buenos Ayres. From the Department.

Perak *Government Gazette* (current Nos.) From the Government Secretary.

Proceedings of the Yorkshire Geological and Polytechnic Society (new series), vol. XI., part II., 1890. From the Society.

Scottish Geographical Magazine (Current Nos.) From the Society.

Synopsis of the Queensland Flora, containing both the Phænogamous and Gryptogamous Plants. By F. M. Bailey, F.L.S. From the Department.

Transactions of the Royal Geographical Society of Australasia (Victorian Branch). Pt. II. Vol. XII. From the Society.

Transactions and Proceedings of the New Zealand Institute, 1889. Vol. XXII. From Society.

Report, twenty-sixth annual, of the Zoological and Acclimatisation Society of Victoria for the year, 1889. From the Society.

Report, Sydney Free Public Library, for 1889-90. From the Trustees.

Report of the Wellington Acclimatisation Society, for nineteen months ending March 31, 1890. From the Society.

Revista do Observatorio, No. 4. Rio de Janeiro. From the Department.

Ver haudlunger der Gesellschaft. Für Erdkunde Zu Berlin. Current Nos. From the Society.

Victorian Naturalist. Vol. VII., No. 1. May, 1890. From the Society.

NATIVE STONE IMPLEMENTS.

Mr. MORTON read a letter which His Excellency had received from Mr. S. S. Rice, London, stating that his friend, Mr. E. B. Tyler, of the University Museum, Oxford, was anxious to procure some of the native stone implements of Tasmania, and asking His Excellency to assist in the matter.

Mr. MORTON stated, in reply to His Excellency, that there was a collection of such stones in the Museum, and also a number in duplicate. Several of the Trustees of the Museum were present, and no doubt the matter would receive consideration at their next meeting.

His EXCELLENCY said that the writer had a great deal to do with the University Museum at Oxford, having evidently made the subject a study. He thought it would be well to send the specimens, if that could be done without denuding our collection.

Mr. C. T. BELSTEAD said he was sure that the matter would receive full consideration from the Museum Trustees.

DREDGING TRIP ON THE DERWENT.

Mr. A. MORTON read some "Notes on a recent dredging trip in the Derwent." He said: "The Tasmanian Fisheries Commissioners having decided to examine the several bays in the River Derwent for the purpose of ascertaining whether as in former times there still existed natural oyster beds, advantage was taken of the opportunity to pay special attention to the marine fauna that might be obtained by means of the dredge. Mr. A. Durrand, F.R.M.S., at present on a visit to Tasmania, who has made a collection of foraminifera from many parts of the Southern seas, accompanied us on our trip. Several bays to the northward of the harbour were tried, but the dredge failed to secure any specimens of oysters, and in only one or two instances did we obtain any dead shells. Although from a commercial point of view the result of the dredging trip proved comparatively a failure, still from a scientific point we were amply rewarded. Instead of finding the oyster a large quantity of pectens or scallops were obtained. As had been pointed out by the Secretary to the Fisheries Commission (Mr. Seager), a large number of this shellfish can be obtained in the River Derwent by means of dredging, and the quality being equal to the European scallops it is to be hoped that steps will be taken by our fishermen to place in the market this class of shellfish, which would readily find consumers. As the places dredged in were rather far up the river the number of species of mollusca was naturally limited. Several crustaceans, chiefly of the smaller kind, were obtained, one kind being found in great numbers inhabiting the common mussel. This curious little crab has a wide range common to the European seas, but, although found inhabiting the mussel of New Zealand, has not been observed in the mussel found round the New South Wales coast. A large number of species of a delicate Echin were met with, a species which is found to have a very wide range, having been obtained on the N.E and North coasts of Australia, Japan, S.E. Coasts of New Guinea, East Indies, Cape of Good Hope, New Zealand, and New Caledonia. Some five or six species of sponges were obtained, samples of which he intended to have forwarded to Mr. Arthur Dendy of Melbourne University for identification, as that gentleman is at present paying considerable attention to the spongidiæ of Australia. Several specimens of foraminifera were obtained. In concluding, he said that from the large number of specimens obtained during the trip, and considering the very primitive and unsuitable dredge in use, he was convinced that a most interesting and valuable collection of marine fauna might be obtained in the Derwent, and accordingly decided during the summer months to carry out a similar system of dredging to that which he was engaged in for the Sydney Museum on the Queensland coast and at Port Jackson during the years 1879, 1881-2. (Hear, hear.)

TASMANIAN MOLLUSCA.

Mr. A. MORTON (for Mr. R. M. Johnston, F.L S.), read a paper on "Provisional aid to the study of the Tasmanian Mollusca." The writer remarked that the student of conchology in Tasmania laboured under a disadvantage in that the description of the various species inhabiting our waters was scattered widely in various publications of Europe and America, while nearly half the number of the principal type species are deposited in foreign museums and are therefore inaccessible for purposes of reference to local students. Much careful work required to be done before we could rest satisfied with existing classification of species, for it was well-known that the specific descriptions of the earlier distinguished collectors who accompanied expeditions to our seas were often too meagre to satisfactorily distinguish or separate them from many allied distinct species subsequently discovered. He suggested that the example of New Zealand should be followed in making up a duplicate collection of our shells as complete as possible, and thereafter submit them to a well-known European authority like Ed. Von Martins, who could critically examine and compare them with original types in European collections, and submit a report for guidance of local workers. If Messrs. Legrand, Petterd, and Beddome, who have so ably worked in this branch of science in Tasmania, and who possess the best local collections, were to engage in a work of this kind under the auspices of the Royal Society of Tasmania, he was satisfied that the very best results would be attained, and we would then prepare the way for the publication of a work on Tasmanian Mollusca upon which thorough dependence could be placed. He alluded also to the labours of the Rev. J. T. Tenison Woods, F.L.S., and the Rev. H. D. Atkinson, of Circular Head, in connection with this study. He gave a comprehensive account of the bibliograpy of the subject, and for the convenience of local students who are not in possession of works of reference, he added a part devoted to the description of the various families, mainly based upon the late G. W. Tryon's splendid work on

"Structural and Systematic Conchology" (April, 1884). To afford additional facilities to such students he prepared an artificial key to the classes, family, and genera, which he hoped would prove to be of service.

Mr. A. J. TAYLOR expressed regret at the absence of Mr. Johnston through indisposition. Mr. Johnston's writings were not only invaluable in themselves, but specially so as they were generally written with a view to meet the requirements of young students.

THE DOUBLE COCOANUT.

Mr. ALFRED J. TAYLOR read a paper on the *coco-de-mer* (*Lodoicea Seychellarum*) or double cocoanut, which had become interesting of late owing to some misleading paragraphs which had found their way into the English Press regarding it.

AUGUST, 1890.

The monthly meeting of this Society was held on Monday, August 12th. The President, His Excellency Sir R. G. C. Hamilton, took the chair.

NEW MEMBERS.

Mr. Thos. Whitelegge, F.L.S., Zoologist Australian Museum, was elected a corresponding member, and Mr. F. Chalk, barrister-at-law, a new member.

A FOSSIL TREE.

MR. JAMES BARNARD read a communication which he had received from Mr. S. H. Wintle in regard to a paper read by Mr. Barnard for him at the June meeting of this year, entitled "Notes on a Fossil Tree found beneath 100ft. of basalt at Richmond, Victoria." Mr. Wintle wrote as follows :—

"I find in the discussion which followed the reading of my remarks by the Vice-President, that Mr. C. H. Grant expressed an opinion that the condition of the wood afforded satisfactory evidence that the basaltic lava which entombed it could not have had a high temperature. A moment's reflection will show that such a conclusion is quite untenable. The degree of heat necessary for molten rock-matter, such as lava, to flow, is laid down by no less an authority on Seismology than Mallet to be from 1,900deg. to 2,000 deg. Fahr., a temperature sufficient to melt copper. Mr. Grant's opinion as to a low temperature of the basalt at the time it overflowed the tree was based, I presume, upon the fact that the wood displays no sign of being carbonised, or charred, beyond a slight trace at its superior surface at the point of contact with the once molten rock. This feature, I take it, is to be accounted for by the fact that the enveloping fluid lava by excluding the air would effectually prevent an access of oxygen to the wood ; and further, that the surface of the lava-stream, which would come in contact with the tree first, is always cooler than the interior or the base of the stream. I also observe that Mr. Grant regards the basalt (a specimen of which accompanied the example of the fossil wood) as 'diorite,' according to the report referred to. With all due deference I would observe that this is erroneous. It is true basaltic lava of that kind known as Anamesite of Pleistocene Age, and not greenstone, which diorite proper is. The newer basalts, which in Victoria have filled up so extensively Miocene and Pliocene valleys, and river channels, are chiefly vesicular zeolitic *dolerites* and *Anamesites*, the former being well represented by the light coloured Malmsbury 'bluestone' so extensively employed in buildings in Melbourne."

MR. GRANT explained that he had only referred to the matter as a suppositious case, and that his remarks had been evidently misunderstood.

Mr. R. M. JOHNSTON said he was not present when the paper was read, but he thought he knew something of the constitution of this fossil. In his work on Geology a section of the book was taken up in describing such fossil trees. From the description given he imagined that this fossil exactly corresponded with those found in the deep leads of Beaconsfield. From the appearance of those fossils it was quite possible that the wood was protected at one time by clay, which formed a protective envelope between it and the overflow of the basalt. The best specimens could be obtained in the railway cuttings at Breadalbane, where a perfect forest of the ancient vegetation of the Mesozoic period was entombed, and destroyed by the scoria and ashes and molten flows of matter from the volcanic eruptions at that time so prevalent in this and some other localities throughout Tasmania. It has been found by mineralogists that if basalt is thrown up by eruptive influence in a state of ashes, and if afterwards chemical action takes place, it sometimes becomes perfectly crystalline, and as if it had been originally in a state of liquefaction. At Breadalbane they were seen in every possible stage. In no country in the world, so far as he was aware, was there exhibited the remains of this vegetation in such abundance in every stage as was to be found in Tasmania.

Mr. **ALFRED J. TAYLOR** said that judging from the remarks recently made by Baron Nordenskïold before the Royal Swedish Society of Arts, it was possible that the wood referred to might have been covered by basalt without being charred. The Baron's remarks were as follows:—"The members of the Academy are aware of the fact that on several occasions I have given reasons which tell against the supposition that the layers of basalt have been formed through eruptions of glowing melted lava. Once in Greenland I saw a phenomenon which, if it had been fully investigated, would have been of great assistance in the solving of this question. Namely, I once met with a thick '*moja*' stream, which was slowly rolling down a steep headland on the north-eastern coast of the Nuorsoak Peninsula, and which seemed to come direct from the basalt mountains. I had great difficulty in crossing this stream, which consisted of a sticky substance. Only after returning home my attention was called to the fact that this substance when hard might probably form the basaltic layers." From these remarks it would be seen that the problem referring to the formation of basalt had not been successfully settled, and that it was quite possible for Mr. Wintle to have been perfectly right in the conclusions he had arrived at with regard to the piece of wood under discussion.

Rev. **J. B. W. WOOLLNOUGH** said that when he was in Iceland, where there was only one living tree, he not unfrequently came across partially burned wood which had been exposed to great heat and overflows of lava, which had been protected evidently by some surrounding substance which had hindered the lava from influencing it as otherwise it would have done. In some cases the wood was only slightly charred, and it seemed to have lost almost completely its weight. When a piece was taken up in the hand it seemed as if all the weight had been pressed out of it. One piece of wood to his knowledge had been under a very thick piece of lava.

ANTARCTIC EXPLORATION.

The following correspondence from the Hon. Secretary (Mr. A. C. Macdonald) of the Royal Geographical Society of Australasia, was read by the Secretary (Mr. A. Morton):—

"Royal Geographical Society of Australasia,
"Society Rooms,
"Collins-street W.,
"Melbourne, July 30, 1890.

"DEAR SIR,—I am directed by the Antarctic Committee to inform you that at a meeting of the committee held at the Melbourne Observatory on the morning of Tuesday, the 29th July inst., the following resolutions were passed:—

1. "The Antarctic Committee learn with pleasure the magnificent offer of Baron Oscar Dickson to defray one half the cost of an expedition to explore the Antarctic region, provided that the other half, not exceeding £5,000, be contributed by the Australasian colonies, Baron Nordenskïold to take command of the expedition. This committee cordially desires to accept the offer, and hereby resolves to appeal to the general public throughout the Australasian colonies for subscriptions towards the movement.

2. "That a copy of the foregoing resolutions be forwarded to the Royal Societies of Queensland, New South Wales, Tasmania, and Queensland branches of the Royal Geographical Society of Australasia, soliciting their co-operation.

"The Consul-General for Sweden and Norway, who was present at the meeting, kindly promised to communicate with Barons Nordenskïold and Dickson, and to transmit copies of the report of the meeting. A committee was formed to prepare resolutions to be submitted at a public meeting to be held during the month of August. Arrangements will be made for delivering one or more public lectures. Already several handsome subscriptions (two of £100 each) have been promised, and the committee feel satisfied that if a reasonable effort is made the required amount will easily be raised.

"In conclusion, the committee respectfully request your cordial co-operation in a movement which is essentially Australian and National, and which should certainly result in the acquisition of knowledge to the world, and the prospective possibilities of profitable investment.

"A. C. Macdonald,
"Hon. Sec. and Treasurer.

"The Secretary,
"Royal Society of Tasmania."

[Telegram.] "Melbourne, July, 31, 1890.
"The Secretary, Royal Society of Tasmania, Hobart.

"At a meeting of the Australian Antarctic Committee held 29th inst., Baron Oscar Dickson's munificent offer to defray half the cost of an expedition under the command of Baron Nordenskïold, to explore the Antarctic regions, conditionally that the Australian colonies subscribe the other half not exceeding £5,000, the offer was cordially accepted, and it was unanimously resolved to appeal to the general public alone (not to Government) for subscriptions in aid of the object. Two members of the Royal Geographical Society of Australasia (Messrs. J. S. Gotch and Professor Kernot), subscribed £100 each, and several other sums have also been promised. Public meetings and lectures are being arranged. His Excellency the Earl of Hopetoun will preside at the inaugural lecture to be held early in August. The Consul-General for Sweden has undertaken to communicate with Barons Dickson and Nordenskïold. The Antarctic Committee respectfully requests your co-operation, and suggests the formation of an Antarctic Committee composed of members of your Society and other leading commercial gentlemen in Hobart. Letters embodying resolutions passed here on 29th inst. and form of subscription list by post.

"A. C. Macdonald,
"Hon. Sec. and Treasurer, R.G.S. of Aust."

His Excellency said: It seems to me that the objects to be gained by Antarctic exploration are so numerous and important, that it seems to be strange that it should have been so long delayed. When we consider that we know almost nothing practically of these regions, that a chart has yet to be made of them, showing which points and coast lines are land and which are merely floating ice, and that the geology, botany, and natural history of this great region are all at present a blank, I cannot conceive of any more worthy field for the explorer from a scientific point of view. Moreover, until we know something of this immense area, we must remain in ignorance of the laws which govern the climates of the globe, and more particularly of the vast continent of Australia. Then again, to us in Tasmania, the nearest of the Australian colonies to these regions, the commercial aspects of the exploration may prove important, for it is quite conceivable that it might lead to a revival of the great whaling industry which was once a staple industry of Tasmania. One feels a certain amount of regret that this exploration should not have been undertaken under the British flag, seeing that the interests of the British Empire in it are certainly greater than those of any other country, but when such a noble offer has been made as that of Baron Dickson, and the opportunity arises of having the expedition under a man like Baron Nordenskïold, I think the least we can do here in Australia is to enter heart and soul into the project, and assist it to the best of our ability. I observe that in Victoria it is proposed to raise the funds necessary by private subscriptions, and not by a grant from Parliament. So long as the money is forthcoming it does not much matter how it is collected, but on this point it would be desirable to ascertain what the views of the members of this Society are. We did all we could to push forward the last proposed expedition, which fell through unfortunately, and I feel sure that now this Society will do all it can to further the present one. I judge from the very moderate sum of £10,000, which is its estimated cost, that it can only be a preliminary and experimental one, but I have no doubt that if it brings back important information, as no doubt it will, that further expeditions will in future be undertaken to set at rest the many scientific questions which are at present locked up in this great unexplored region.

BISHOP MONTGOMERY said that before he left London he had expressed the hope that he might yet have the South Pole in his diocese. (Laughter.) This expedition was important not only from a commercial point of view, but also because it was desirable to gain a clear knowledge. We were necessarily called upon to ascertain all about our own Hemisphere, of which Tasmania might hope one day to be mistress.

Mr. JAMES BARNARD alluded to the previous movement in favour of this object when a committee was formed in 1886. He surmised from a communication he had received that that committee was now merged in or superseded by the present movement. He also considered it a matter of regret that England had not taken part in the expedition, but inasmuch as science knew no nationality, it was, from a scientific point of view, a matter of indifference whether England took her share or did not do so. With regard to subscriptions, he thought that the Government should be approached to contribute the colony's share. It seemed to him that from an expedition of this description there was no individual benefit to be derived, the benefit would be a national one, and looking upon the matter in this light he considered that the Government should be approached to give the approximate share justly due by Tasmania as a colony largely interested in the expedition.

Sir LAMBERT DOBSON said it seemed to him that this must be a question of interest to everyone who had any regard for science. The world had now left comparatively little *terra incognita* that had not been penetrated by the explorer, and this was the only remnant of undiscovered region that concerned us. If there was any profit to come out of the expedition, or any climatic benefit, doubtless Hobart would derive the advantage. Hobart was the starting point of the last Antarctic Expedition, and he remembered the sailing of the Erebus and Terror. They had also the work of Lieutenant Hooker remaining amongst them as a standard work, and the meteorological observatory established here had proved of benefit. There was a general desire to see the far South explored, to find out if there were any fresh discoveries to be made, and he thought, whether the money came from individuals or the Government, they would all be glad to see Tasmania take part in the expedition.

Mr. A. MORTON said that in 1886 the late Mr. Sprent read a paper on this subject, and it was then contended that there should be a combination of the colonies in carrying out the expedition. The project fell through at that time until now, when it was again revived. He called attention to the footnote in the circular—"Subscriptions will be returned in full in the event of the expedition failing to start from Hobson's Bay"—and said he had written for further information on the point, as to whether the same object might not be attained by the expedition starting from Hobart or New Zealand if it was found more advantageous to do so. In 1886 Victoria led the way in this matter, followed by Tasmania, which was very enthusiastic, a deputation waiting on the Premier; afterwards New South Wales took the matter up. On this occasion Victoria again took first place, and he was glad to think that Tasmania was again second. He thought that on such an occasion the words of the late Mr. Sprent were worthy of recollection when he said, "It would be a standing disgrace to Australia if she took no part in the exploration of the seas that wash her own coast." (Hear, hear.)

Mr. **Alfred J. Taylor** said it seemed to him that if they wished to make the history of the future, they could not do it in a better way than by supporting the expedition now under consideration. He had received several communications from the Secretary of the Royal Geographical Society of Australasia on the subject, and he trusted that something practical would be done by the appointment of a committee in Hobart.

Mr. **Curzon Allport** said that this was a question which would involve considerable discussion, and he thought, in view of the other papers to be read that evening, that it would be as well if this subject was adjourned for future discussion. While agreeing with the last speaker as to the appointment of a committee, he totally disagreed with the proposal to make the paltry sum required a matter for the Government. The object of the Royal Society was to deal with subjects of this sort, and he hoped that they did not require to go hat in hand to the Government for the necessary sum. He considered that they would not be doing their duty if they followed the course proposed. He hoped they would be prepared to contribute a substantial amount to this object, and speaking for the Photographic Art Association, he had no doubt but that they would join in the contribution. Reference had been made to the Antarctic regions as a place of great mystery, but already they had been partially explored, and at next meeting he promised to produce a series of photographs of those regions, not taken by the Eurebus and Terror expedition, but by the officers of some French discovery ships. He had do doubt they would be of interest to the members. (Applause.)

Mr. T. D. **Stephens** seconded, and hoped the Council in the *interim* would continue its work, and place before the Society a practical scheme at next meeting.

The motion was agreed to, and the discussion adjourned.

Mr. A. Montgomery, M.A., Government Geologist, read a Paper, entitled "Notes of some Geological Observations on the West Coast."

Mr. R. M. **Johnston** said he was sure that the members had listened with plêasure to Mr. Montgomery's paper, which was very interesting to all geologists. He had travelled on several occasions across the island, and also from North to South, and the igneous rocks had also excited his attention, especially the serpentines and greenstones. He had observed at the Queen and King Rivers rocks similar to those described by Mr. Montgomery. Between that locality and Macquarie Harbour there is an interesting section showing the Upper Silurian rocks, and he had made a large collection of Upper Silurian fossils from that region. The sandstone to which Mr. Montgomery referred occurred in several places between the Queen River and Macquarie Harbour, and at the 14-mile Hut, near the Magnet Range. This sandstone in both localities is closely associated with the serpentines, and the former is very rich in the remains of brachiopods, on account of which this sandstone was originally called by him *Brachipodos Sandstone*. There was also a very important serpentine rock described by Mr. Chas. Gould in the neighbourhood of Ilfracombe which was associated with important iron deposits that failed to be worked successfully owing to the existence of chromium in a free state. He believed that a similar relationship existed in connection with the rocks near Penguin. The importance of this paper could not be over-estimated, and he hoped the reading of it would lead to new interest being taken in the science leading up to an intelligible account being prepared of the order of rocks from Mount Heemskirk on the west to Patrick's Head on the east.

Mr. **Curzon Allport** thought that the Secretary (Mr. Morton) was entitled to credit for the pains he took in arranging to have such excellent papers read before the Society. The paper just read brought before them matters of great importance, and he thought such an important subject could not be dealt with upon one evening. He suggested that the consideration of the paper should be adjourned till next meeting, when he would be able to produce some information on matters touched on in the paper, and also photographs of some of the districts on the West Coast.

Mr. **Alfred J. Taylor** seconded, and the motion was passed.

FERNS.

Mr. **R. M. Johnston** read some notes on a fern which had been found at George's Bay by Mr. George Hinsby, and was submitted to him by Mr. Leonard Rodway. He described it as belonging to the Bleechnum Cartaligenum, a species common to Australia, but hitherto unknown in Tasmania.

Mr. **A. Morton** read a paper entitled "A complete list of ferns found in Tasmania, with full descriptions of the genera and species," in which he had adopted the elaborate description, as published by Mr. G. Bentham, F.R.S., in his "Flora Australiensis," giving wherever practicable the authorities and localities where the fern is found, also the localities in which the species is found in the other colonies. It was his intention, if possible, to have the list of ferns of Tasmania illustrated.

Sir Lambert Dobson said that all those who took an interest in Botany would be be glad to find that a good description of ferns has been compiled. They had this shortly done in Spicer's book, but this would be much more complete, and would be of great interest to all who enjoyed a walk in the bush. Comparatively few knew the number and names of the ferns, but this book would enable them readily to identify the plants. At one time, when Sir Henry Lefroy offered a prize of £5 for the best collection of ferns, he made a collection of 50, comprising every fern he knew of in Tasmania. He was very much pleased to see that Mr. Morton had given his attention to this matter, a pleasure which would be shared in by all those who took an interest in this attractive branch of science.

A GUM TREE GRUB.

Mr. **Alfred J. Taylor** submitted the branch of a gum tree sent by Mr. Ward, Government Analyst, which had been eaten off by a grub.

His Excellency in moving the usual vote of thanks to those who had read papers, expressed the pleasure with which they had listened to Mr. Montgomery's paper, and hoped they might often receive papers from that gentleman. (Hear, hear.) He was sure that they all agreed that Mr. Morton's work would be of very great interest, and he had no doubt it would assist in cultivating a love of flowers among the rising generation. (Applause).

The vote of thanks was cordially passed, and the meeting adjourned.

SEPTEMBER, 1890.

The monthly meeting of this body was held on Monday, September 15. The President, His Excellency Sir R. G. C. Hamilton, took the chair. There was a good attendance of Fellows, and a large number of ladies were present, including Lady Hamilton.

NEW MEMBER.

Major-General Tottenham was elected a Fellow of the Society.

ANTARCTIC EXPLORATION.

Mr. MORTON reported that at a meeting of the Council of the Society the following resolution was agreed to:—"That this Society desires to express its sympathy with the proposal for the despatch of an expedition to the Antarctic regions, under the conduct of Baron Nordenskïold, and resolves that active steps be taken to collect subscriptions in aid of so desirable an object, the Royal Society heading the list with a donation of £50."

Mr. THOS. STEPHENS moved the adoption of the resolution by the Society. Most of the members would agree that it was desirable that the little known country in the neighbourhood of the South Pole should be explored, and something more known of it. It was now something like 60 years since the last attempt was made to gain any information about these southern regions, and from various circumstances that experiment was practically abortive. Perhaps the most interesting discovery during the voyage of the Erebus and Terror was the two magnificent volcanoes named after the exploring ships, and which are, perhaps, without a parallel in the known world. He did not think that the expedition should be taken up in a commercial spirit, as was suggested by some friends in the other colonies, and with the almost certain project of re-establishing the whale fishing. If people started with a foregone conclusion of that kind, he was afraid that they would be disappointed. It was better that the expedition should rest on the ground that it was undertaken in that spirit of enterprise which was the peculiar property of the Anglo-Saxon race all over the world—(hear, hear)—and with a desire to get rid of that feeling of shame which they must have at knowing so little of a country which was comparatively close to us. Much would be gained in the cause of science and otherwise by a well equipped expedition. It was incumbent on all those who could do so to help in removing some portion of the veil which now hangs over the southern part of the world. He had pleasure in submitting the resolution for the approval and concurrence of the members of the Royal Society.

Mr. JAMES BARNARD seconded. Usually the Council possessed the power to transact all business of the Society, but when the resolution agreed to involved the expenditure of money, it was thought advisable that it should receive the concurrence of members. He did not propose to speak at length, as he considered that the subject had been thoroughly thrashed out, and it was like "painting the lily" to expatiate upon it. They were simply following the example of the Councils of the different societies of Australia in voting this sum, which was in proportion to their limited resources.

Mr. A. MAULT did not intend to propose an amendment, but desired to explain why he should vote in the negative. It was because he so heartily agreed with almost every word Mr. Stephens had said that he thought the course proposed was unfortunate. They all regarded with something like a sense of shame the fact that they knew so little of a locality that was nearer to us than any other part of the world, but he did not think that that sense of shame would be taken away by the consideration of the fact that the work was proposed to be done, not by us, but at the instigation, and with the assistance of persons on the other side of the world who do not belong to our race or speak our language. He very heartily appreciated the motives which had induced Baron Nordenskïold to make this noble offer, and would not say a word against it, but he still thought that in a matter of this sort it was a disgrace to the Australasian Colonies that the work should be in any way taken out of their hands, or conducted in a manner over which they could not exercise control. The Colonies were perfectly willing, as he was sure they were capable of doing the work, and if they took the matter in hand he was convinced that it would be much better than if done under what must be the divided counsels of people on the other side of the world and those now taking part in it from this side. The Australian Colonies were now beginning to found a Navy, and he hoped that it would gain as bright laurels in the South as the Navy of the Mother Country had gained in the North. He thought that it would be a great pity if the carrying out of such an expedition as that proposed should be in any other hands than that of the Australian Colonies.

His Excellency: It would be more in order if you propose an amendment.

Mr. Mault said he would rather vote against the motion a direct negative.

Mr. J. B. Walker suggested that voting on the question should be postponed until other matters relating to the subject were discussed, and this was agreed to.

Mr. A. Morton read a satisfactory progress report of the Joint Committee of the Royal Geographical Society of Australasia (Victorian Branch) and the Royal Society of Victoria, on the proposed Swedish expedition to the Antarctic regions. It stated that the Council of the Victorian branch of the Society had been authorised to head a subscription list in aid of the proposed expedition with a donation of £200 from the Society's funds. The starting point was altered from "Hobson's Bay" to "an Australasian port," and communication had been made with the various colonies in order to get the co-operation of the various Royal Societies in an appeal to the public for funds in aid of the proposed expedition.

Mr. J. B. Walker read a short and interesting account of the last Antarctic expedition, taken from Sir James Ross's book on the Antarctic expedition of the Erebus and Terror. The paper was illustrated by a map of the discoveries made, and in conclusion he said that whales existed in great numbers, and valuable seals might be obtained; while Ross spoke of enormous beds of guano which were practically inexhaustible. The result altogether would not, he thought, be of much value commercially, but of very great advantage to science in such problems as whether the South Pole, like the Northern regions, had once enjoyed a temperate climate, and what effect those regions had on the Tasmanian and Australian climates. The Antarctic regions were within a week's steam of Melbourne or Hobart, and he made an earnest appeal to Australasia to undertake the important work of exploring that region.

Mr. A. Morton read a paper entitled, "What Science and Commerce may gain from an Antarctic Expedition." He referred to the scientific results that had been obtained from expeditions to the North Pole in the way of the confirmation and correction of scientific theories relating to ocean currents, magnetic deviations, climatology, geographical distribution of plants, animals, etc. In respect to commerce, mention was made of the discoveries of the White Sea route to Russia and its consequent trade, the establishment of the Spitzbergen fisheries, and the opening up of new lucrative whaling grounds in Baffin's Bay. The result of Captain Ross's trip to the South Polar regions gave magnetic researches of the highest value. Although Captain Cook had predicted that no man would venture further than he had done, viz., lat. 71deg. 10min. S., Captain Ross had penetrated 420 miles further south from the point at which Captain Cook turned back. While heartily in sympathy with the proposed expedition under Baron Nordenskiold, he thought that £10,000, the amount proposed, would prove inadequate to obtain great results, or to win more information than had been already obtained. He suggested that England and Australia should unite in sending a properly equipped expedition to the Southern Polar Sea under naval auspices and naval discipline.

HIS EXCELLENCY said that the Society would now further consider the resolution before it.

Mr. A. J. TAYLOR thought that as it had been decided that the expedition should be a joint Swedish and Australian one, it would be a pity to throw difficulties in the way of carrying it out. At the same time everyone sympathised with Mr. Mault's objection, and he suggested that the motion should be amended to express regret that the expedition had not been taken in hand by the Australian colonies.

Major-General TOTTENHAM thought the Mother Country should also be asked to assist.

HIS EXCELLENCY asked Mr. Mault if the motion as amended by Mr. Taylor would be acceptable to him.

Mr. MAULT said he did not wish to oppose anything that the Council of the Society thought expedient, but he thought that everything said subsequently to his remarks had confirmed what he had said. The noble words of the *Argus* in regard to the glory that awaits Australasia in accepting this duty, and the equally noble words of Mr. Walker, should have actuated a little more the different learned societies that have taken up this matter. It was a descent from this noble incentive to think that they were doing their duty by sending £5,000 from Australasia to help the Swedes to carry out the expedition. He could not accept any modification of his views, as had been indicated, but thought the question had better be debated on its merits, and the question decided whether they should or should not assist in this movement.

Mr. J. B. WALKER supported the motion. He would have preferred that England and Australasia should have taken up this work, but he was afraid that years would elapse before they were stirred up to the point of enthusiasm under which they would undertake the work. He thought that when Baron Nordenskïold, an experienced navigator, offered his services, and also to pay one-half of the expense, if Australasia would supply the other half, it would be ungenerous to say that they would not help. At the same time he hoped that this expedition would be the precursor of one of which Australasia might be proud. (Hear, hear.)

The motion was then put and carried.

Mr. JAMES ANDREW moved,—"That the Council of the Society carry out the work in connection with the proposed expedition."

Mr. J. B. WALKER seconded, and the motion was agreed to.

STRIKES AND REAL WAGES.

Mr. R. M. JOHNSTON read a paper entitled "Observations on the Influence of Strikes upon Real Wages." He described himself as one who regarded combination or co-operation amongst wage-earners as of paramount necessity to them, and that when all better modes of appeal for reasonable concessions are unavailing, the last and terrible resort "to strike" may in certain cases not only be justifiable but imperative. But a strike could only succeed in raising real wages when it was partial or confined to industries that comprise a small proportion of the community. A strike might be the means of successfully raising the status of some branches of labour that are comparatively underpaid or overworked; it might raise the real wages of a particular country or locality which formerly laboured under the average remuneration of other countries; it might temporarily be the means of forcing the capitalist or employer to give a fairer or larger share of the profits of capital and labour, *i.e.*, machinery, plant, skill, and labour—but from the very nature of the common source of all profit and wages, viz.—the current products created by the combined services of capital (instruments) and labour), strikes could not raise the real wages of all wage-earners. Strikes could not increase the real wages or the purchasing power of a day's labour of all wage-earners. In a word, they could not divide more than what has actually been created or produced, although the nominal rates of wages and nominal prices of commodities may both be raised to any extent without real benefit to anyone. To secure a general nominal rise of wages in all branches of labour would further have the immediate effect of lowering once more the real wages of those who already had effected for themselves an advantage by successful combination or strikes. Strikes might possibly raise the nominal wages of workers all round a hundred-fold, and yet result in the positive lowering of the real wages of all workmen who, by means of organisation, hitherto have succeeded in bettering their condition as compared with their less perfectly organised fellow-wage-earners. It was the failure to recognise the essential difference between real and nominal wages that rendered futile the many schemes of sentimentalists, which have for their object the laudable design to improve the condition of the people. In conclusion, he thought it would be well for capitalists and wage-earners, employer and employed—whose interests as producers and consumers are almost identical—that when matters requiring adjustment are proposed, there should be greater facilities afforded to the Councils of both interests for securing a friendly settlement. To the absence of these facilities, and the adoption of high-handed action, was mainly attributed the disastrous evils of strikes.

Major-General TOTTENHAM suggested, as a solution of the labour difficulty, that wages should be fixed for a year, and a month's notice given of any change.

HIS EXCELLENCY thought it would be better that the discussion be confined as much as possible to the statistical and scientific effect of strikes. (Hear, hear.)

Mr. MAULT said that if the discussion was to proceed on the lines suggested, an opportunity should be afforded of considering the paper read. He would move the adjournment of the debate.

This was agreed to.

THANKS.

HIS EXCELLENCY moved a vote of thanks to the gentlemen who had read papers, and a special vote of thanks to Dr. Agnew, who had presented the Society with three volumes giving a report of the scientific results of the exploring voyage of H.M.S. Challenger, 1873-76. The volumes are beautifully illustrated.

The votes of thanks were cordially passed, and the proceedings terminated.

OCTOBER, 1890.

The monthly meeting of this body was held on Monday, October 13. The chair was occupied by the President, His Excellency Sir R. G. C. Hamilton, and there was a good attendance of Fellows. Several ladies were also present.

NEW MEMBERS.

The following gentlemen were elected Fellows:—F. J. Jacobs, J. H. Downie, W. G. Browne, L. Chambers.

Mr. T. A. Urquhart, of New Zealand, was elected a corresponding member.

The secretary drew attention to three specimens of Salmonidæ hatched from the late shipment of ova brought out by Sir Thos. Brady, the gift of the Hon. J. W. Agnew. The fish were obtained from the Salmon Ponds, one answering undoubtedly to the description of the true salmon, the other two being unmistakably trout, clearly showing that with all the care and attention paid to the selection of true salmon ova by Sir Thos. Brady, certain ova of trout had been sent out with the late shipment It was extremely satisfactory to learn that, although there appeared to be a mixture, a very large percentage agreed to the description of the true *Salmo salar*. He also directed attention to the fish caught on Saturday in the Derwent, which, he said, although a very fine fish, did not agree with Gunther's description of the true *Salmo salar*, but similar to the fish recently caught in the Huon by the President. A gentleman passing through Hobart, and whose experience in the matter was that of having been a manager of a Scottish salmon fishery, had viewed the fish, and pronounced it to be a bull trout.

Mr. JOHNSTON questioned whether the different circumstances surrounding the fish in these waters had not occasioned a breakdown of the racial distinctions between the *Salmo salar* and the *Salmo trutta*, together with the theoretical classification of the true *Salmo salar*. The circumstances also tallied with the experience of New Zealand in this matter.

Mr. MAULT asked had this change of the surroundings had any effect upon the quality of the fish.

Mr. JOHNSTON considered the flavour qualities of the fish would be equally affected with the other qualities of the fish. The question he had just raised had never been put to any Home authority. This degeneration of the qualities of the fish was experienced in different waters in Scotland, the finest fish being found in the colder waters.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Secretary stated that he had received a letter from Professor Hutton, of the Canterbury University, Christchurch, New Zealand, stating that the New Zealand Government had passed a vote of £500, and that the Government Printer had been instructed to do all the printing required by the Association free of charge; also that the hon. sec. had been authorised to frank all telegrams, letters and parcels in connection with the Association. The meeting to take place in January, 1891, and considering that the next meeting would be held in Hobart the following January, 1892, it was to be hoped the Government would act as liberally as the New Zealand, Victorian, and New South Wales Governments had done, the two latter having voted sums each to the Association.

Mr. R. M. JOHNSTON said as the New Zealand gathering was approaching it would be well to get an expression of opinion from the people of the colony and the Government as to the welcome which would be extended to the Association, because this should be ascertained before the meeting in question, so that the representatives of Tasmania might be in a position to reiterate their previous invitation to the Society to hold its 1892 meeting in Hobart. He moved that the Council wait on the Government, and ascertain what they are willing to do in the matter.

The motion was agreed to.

ANTARCTIC EXPEDITION.

A subscription list for this Expedition was laid on the table.

TASMAN'S JOURNAL.

Mr. J. B. Walker read a paper on "Notes on the localities mentioned in the journal of Tasman's discovery of Tasmania." In this he sketched the two voyages made by Tasman, in the first of which he discovered Tasmania and New Zealand (1642), and in the second of which he explored the west, north-west, and north coasts of Australia and the Gulf of Carpentaria (1644.) These voyages completed the circumnavigation of New Guinea and Australia. The writer then proceeded to identify the parts of the Coast mentioned by Tasman, and the conclusion he had arrived at regarding the land fall made by the discoverer was that it was the high land north of Macquarie Harbour. He then proceeded to discuss the site of Tasman's anchorage on the East Coast near Cape Frederick Henry, and pointed out that the name of Frederick Henry Bay, now applied to part of Storm Bay, was originally given by Tasman to what is now known by the name of Blackman's Bay.

Mr. Mault described a method in which he had traced Tasman's land fall, fixing it slightly further south than Mr. Walker. There were three maps in the British Museum among the additional manuscripts, No. 8,946, which had never been published. It would be well if the Government could be got to publish these.

NEW TASMANIAN SPIDERS.

Mr. Morton stated that he had lately been making a collection of Tasmanian spiders. Some of them he was unable to determine, and had forwarded to Mr. A. T. Urquhart, of New Zealand, the collection for examination. Mr. Urquhart was one of the best authorities in the colonies on spiders, and on examining the collection he had found some new species of the genus *Eperidæ* five new kinds of that genus, two new species of the genus *Thalaosoma*, while he had been able to form two new genera which he had named *Alrea* and *Collina*. Accompanying the paper was a plate of the species referred to.

OSTRICH FARMING.

Mr. James Andrew read a paper on the subject of ostrich farming, and the possibilities of successfully introducing this industry into Tasmania. The remarks set forth were based on personal observation of wild ostriches, and experience of the management of the bird in a domesticated state. After a brief sketch of the bird and its habits, together with some of the uses to which the eggs are put by Bushmen, the writer proceeded to deal with the subject of ostrich farming, and pointed out that the Egyptians were the first people who had undertaken the taming and utilisation of the bird. The first modern step in this direction occurred rather less than 30 years ago in Cape Colony. It was not necessary to have large enclosures in which to confine the domesticated birds for herding purposes, but each pair required to be separated. The male bird was most pugnacious during the nesting season, and could only be approached in safety with great precaution. The formidable character of a kick from an ostrich was exemplified by the fact that at Graff Reinet the back of a horse was broken by one such blow. The best means of escaping injury when attacked by the bird was to lie down and submit to the inevitable pummelling he would administer. The writer inclined to the natural hatching of the eggs by the birds as preferable to the use of incubators, although the incubator was an essential appliance for use in the case of emergencies. The process of clipping and preparing the plumage for market was described, followed by examples of high prices paid a few years ago—the halcyon days of ostrich farming for both bird and plumage. The growth of the industry in Cape Colony was such that from 80 tame ostriches in 1865, in 10 years the total had reached 32,247, and the export of feathers was 49,969lb., valued at £304,933, and in 1882 feathers were exported to the value of £1,093,939. Recent statistics showed that the supply had exceeded the demand, and the enomous profits arising in the past from the sale of the young birds and feathers would never again be realised, but substantial recompense would still be earned by a skilful and intelligent management. The bird could be raised in any temperate climate, and dry level wastes might be found suitable for the industry. In Africa the birds had so lost their value they were not worth recovering when they strayed, and it was proposed to repeal the Act protecting the bird.

COMPLIMENTARY.

The PRESIDENT moved the usual vote of thanks to the contributors of papers, after which the meeting adjourned.

NOVEMBER, 1890.

The last monthly evening meeting of the present Session was held on Monday, November 17th, 1890. The PRESIDENT, Sir R. G. C. Hamilton, was in the chair.

NEW MEMBERS.

Messrs. A. J. Ogilvy and A. R. Browne, M.A.M.I.E., F.G.S., were elected Fellows of the Society.

AUSTRALASIAN ASSOCIATION.

The Secretary (Mr. A. Morton) read a letter from the Hon. P. O. Fysh, Premier, intimating a vote of £500 from the Government towards defraying the expenses attendant upon the 1892 session of the Australasian Association which is to be held at Hobart. He also intimated that congratulations had been received from New South Wales, Victoria, and New Zealand, at the proposed arrangements for holding the meeting here in 1892.

STRIKES AND WAGES.

Mr. A. J. OGILVY read a paper, in which he asked the question, Can the toiling masses really improve their condition by these incessant and unhappy strikes, or are they only beating their hands against the iron bars of inexorable economic law? The paper was a reply to the paper read by Mr. R. M. Johnston at the September meeting on the influence of strikes on real wages. Dealing in the first place with the question as it affected primary industries, that is those which are concerned in extracting or producing the raw materials of wealth from the land as in agriculture or mining, he contended that in all such industries every increase of wages would come out of rent. He regarded rent as the surplus which remained after paying working expenses and tenants' ordinary profit. Every rise in the expenses or fall in the profits would reduce the rent proportionately, and, therefore, he concluded that in every department of industry which is concerned in supplying the raw material of wealth from the land, every enforced rise of wages will be clear gain to the labourer, but the loss would fall on the landlord, and stay there. In the secondary industries of manufactures and commerce which were engaged in working of and distributing the material produced by the primary industries, increased wages signified increased price of goods. Those goods were of two kinds—those which the masses consumed, and those which they did not. After pointing out that a vast proportion of industry was concerned in providing luxuries and enjoyments for the rich, he concluded that in all those commodities which the underpaid do not consume, the loss due to increased wages would fall upon the overpaid, and stay there, again leaving the whole net gain to the labourer. On those goods which the masses consumed the strikers would suffer loss, but the loss would not equal the gain. It was said that if the upper classes lost so much there must be so much less employment for labour, and so the loss will come round to the labourer after all. He maintained, however, that there would be no less employment. For, he asked, why will the upper classes have got so much less? Simply because the lower class have got so much more. It is not a loss, but a mere transference of employing power. What the masses want more money for is to spend it, and they can only spend it in purchasing goods and hiring services just as the upper class did They will in short, to the extent of the transference, be employed by each other instead of by their old employers. There was, of course, a limit to the rise of wages, but this limit was a long way off. The labourer could not earn more than his labour produced, but what the labourer actually got was a very small portion of what his labour produced. In conclusion he pointed out that a more equitable distribution of the produce of labour was a boon so great in itself as to be well worth some cost, and that we need not be dissatisfied because less luxuries are produced for the few very rich, if more comforts are provided for the many poor; not even though the loss in value on the luxuries exceeds the gain in value on the comforts.

Mr. R. M. JOHNSTON read a paper criticising Mr. Ogilvy's views. He said it afforded him great pleasure to find himself in agreement on so many points with one like Mr. Ogilvy, whose well-known generous sympathies for the amelioration of the condition of the masses of the people must command the respect of all right thinking persons. He took exception, however, to several of Mr. Ogilvy's arguments, notably to that regarding rent. He favoured Ricardo's theory, now almost universally accepted, that "the rent of land is determined by the excess of its produce over that which the same application can secure from the least productive land in use." He also laid it down as an accepted doctrine of political economy that rent formed no part of the price of agricultural produce. He dwelt at length upon this point, and illustrated by a table that any increase in wages must fall upon consumers and not upon rent of landlord or the profit of the capitalist. He combated the idea that the rich spent more in luxuries, pointing to the large sums spent by the working classes in liquor and tobacco. He held that Mr. Ogilvy's objections to his papers were based upon assumptions which could not be sustained when subjected to close scrutiny, and he could only re-affirm that it was by increase of savings properly applied in the creation of instruments, which will still more greatly multiply the power of man that any improvement in the condition of the masses can be successful. Without this the mere raising of wages could only benefit a few industries at the expense of the many.

Mr. OGILVY said that the Society had now the two aspects of the question before them, and it was for the members to judge. Mr. Johnston had based his arguments principally on the generally accepted opinion of Ricardo, but it should not be forgotten that the British Parliament had repudiated it, in regard to the Highlands of Scotland and Ireland, by the establishment of Land Courts, which introduced an artificial element into what was held by some economists to be a natural law. In regard to what Mr. Johnston said about the rent forming no part of the price of agricultural produce, there were some farmers present, and he asked them if they had to pay twice as much as they now did for their labour, would they pay as much rent?

Mr. W. E SHOOBRIDGE also spoke on the subject at some length, pointing out that the prices of labour were to a great extent fixed by combinations which had been the secret of the success of all strikes. He hoped the time would speedily come when arrangements would be made whereby the labourer could get his fair share of the products of labour without recourse to strikes.

ACTINOMYCOSIS AND TUBERCULOSIS.

Dr. BARNARD read a paper on this subject, dealing with its transmissibility of bovine diseases to human beings by the consumption of the meat of diseased animals. He showed that such diseases had been transmitted. A central Hygienic Institute was recommended by the last Intercolonial Stock Conference, to which all cases of disease amongst animals should be referred from all the colonies. Without some such institution it was not easy to see how they could be informed to what extent these diseases prevail in our midst. He considered that a similar institution should be founded in connection with the Health Department of this colony, as modern science now was not content with mere superficial examination, but proceeded with more strict and reliable methods to detect the micro-organisms which are undoubtedly the active agents in the production of disease. The paper was illustrated by microscopical specimens of these diseases prepared by Mr. Archibald Park, M.R.C.V.S.

COAL SPECIMENS.

Mr. CURZON ALLPORT showed a number of specimens of coal from the mines at New South Wales, and New Zealand.

PRESIDENT'S ADDRESS.

The PRESIDENT then delivered the following address:—

Fellows of the Royal Society.—During the session of 1890, which this evening comes to a close, the number of our Fellows has been increased by sixteen, and of our Corresponding Fellows by two. The additions to our library have been very satisfactory, and include the three handsome volumes containing the record of the Challenger Expedition, for the gift of which we are indebted to our honorary secretary, Dr. Agnew. I am personally gratified to learn that the Encyclopædia Britannica, which I presented to the Royal Society in the beginning of the year, is being largely referred to by members, who find it of much assistance to them in some of their studies and investigations. The annual proceedings of kindred societies throughout the world, which form perhaps the most important part of our Library, are constantly increasing, and here I would point out that, having regard to the time which often elapses before such volumes are printed and distributed, we may regard with some satisfaction the fact that at our opening meeting this session we had on the table the printed proceedings of our Society for 1889. It is true that this is the first time that this has been done, but I think we may feel pretty sure that our energetic secretary, Mr. Morton, having accomplished this once is not likely to observe less promptness in the publication of our annual proceedings in future. Our monthly meetings have been well attended, and 22 papers have been read before us. In Zoology we have had five papers. The first by Mr. R. M. Johnston, entitled "Further Observations upon the Fishes and Fishing Industries of Tasmania, together with a revised list of indigenous species." Eight years have elapsed since Mr. Johnston contributed a similar paper to this Society, and during that time, from additions made mainly by Mr. Saville-Kent, Mr. Morton, and Mr. Johnston himself, the 188 species then known have increased to 214. The next, also by Mr. Johnston, on "Tasmanian Mollusca," in which he points out how much there is to be done in connection with this subject to secure a satisfactory classification of species. Then we have had a paper by Mr. A. T. Urquhart, of New Zealand, on some Tasmanian spiders sent to him by Mr. Morton for examination, in which he pronounces the collection to contain not only several new species but also two new genera. Mr. Morton contributed an interesting paper on a recent dredging trip in the River Derwent. He was fortunate in being accompanied on this trip by Mr. A. Durrand, a Fellow of the Royal Microscopical Society, who has made a collection of foraminifera from many parts of the Southern Seas, and who, it will be remembered, at one of our meetings exhibited some interesting microscopical preparations of these, and of other minute marine organisms. Owing to the primitive description of dredge used on this trip, the results from a scientific point of view were not so great as they might have been, but they were quite enough to justify Mr.

ROOT MATTERS IN SOCIAL AND ECONOMIC PROBLEMS.

By R. M. Johnston, F.L.S.

(2nd Series.)

Natural Limits to the Numbers Engaged in Various Occupations.

Most writers on social problems tacitly assume that no other considerations than those of supply and demand, or competition and remuneration, need be taken into account when questions relating to the numbers that may be employed in the various branches of human industry are concerned. Indeed so able an exponent of the principles of Political Economy as Mr. Henry Sidgwick, assumes with confidence that the adjustment of the apportionment of the employed in the various divisions of industry is sufficiently determined by "rates of remuneration." He states (p. 182 "Principles of Political Economy"): "We assume that labour and capital are *mobile* or capable of being attracted by a higher rate of remuneration, both from district to district, and from industry to industry, so that not merely are the wages paid for the same quality in any one industry approximately the same, but also when the remuneration of labourers or capitalists in any industry is known to be higher than that of labourers or capitalists in some other industry entailing no more sacrifice or outlay, and requiring no scarcer qualifications, the difference tends to be gradually reduced by the attractions which this higher remuneration exercises on actual or prospective labourers or employers."

There is not the faintest recognition here of natural limits to or absolute necessity for employment in a given direction, irrespective of the aggregate intensity of energies expended, or market rates and prices. Neither does he recognise the universal truth in matters animate and inanimate, that mobility or movement in a new direction requires a fresh expenditure of force commensurate with the nature of the subject, the time occupied in transition, and the friction to be overcome due to inertia or foreign resisting media. A physicist would never dream of discussing the mobility of material substances in such a loose way. He would first consider the mass or weight of the substance: the distance and direction of movement: the rate of movement and time: and the friction due to inertia or existing diversity of movement: and from these he would compute the fresh demand upon energy or force to execute the desired movement.

Because the Political Economist does not think, or does not choose to think, that the transfer of a labourer or capitalist to a new place, or to a new kind of occupation, involves a process analagous to the movement of inanimate bodies, it is not the less true. Take the case of a shoemaker reduced to a state of idleness, or partial idleness, by competition among excessive numbers, or some other cause, locally or generally.

We will suppose that this workman has a family of 5 persons, including himself, to provide for, in addition to his quota of expenditure required for State purposes, such as General Government, Law and Protection, including Gaols, Military and Naval Defences, Police, Education, Public Hospitals, Asylums, support of Paupers, etc.

It is obvious, therefore, that when fairly employed in this branch of labour—making boots and shoes—he is not merely rendering reciprocal services to his countrymen, but he helps them to provide for such expenditure as the requirement of the particular State demands. The greater the effort or energy expended by him during the year, the greater is the value of products by him added to the common wealth, in all these respects, in addition to the important part of support of the four dependants specially related to him.

Under ordinary circumstances (excluding foreign interference, and making due allowance for special skill), all branches of services within a certain country are paid at rates of wages which are, broadly speaking, correlative to effort or time expended, and consequently so long as the rates of wages are locally proportionate to definite effort and skill, it matters not whether the average rate per hour be nominally high or low, so long as expenditure is also determined locally by such correlative conditions. Thus, take the following illustrations: Suppose the price of bread is determined by a daily effort of 10 hours, and that all other services are modified and constantly exchanged in prices which, whether high or low, are also proportional to the *nominal price* of, say, the *quarter of wheat.* Under such circumstances it would not matter to the shoemaker whether the *nominal* amount of his wages was high or low, for it would have the same *purchasing power* over the things which he required to satisfy the wants of himself and family, besides the proportion required from him for the *service* of the State. Thus if the standard—the *quarter of wheat*—bore always the same relation to his remuneration for 10 hours labour and to the various items of his expenditure, it mattered not a whit to him whether the nominal money cost of wheat was high or low. In Australia the average relation between a breadwinner's effort expended and a quarter of wheat usually represents 44½ hours labour, equal to 5½ days labour (8 hours) nearly. If, therefore, the quarter of wheat, and other things (including expenditure) always bore a corresponding relation to each other, as 44½ hours common labour bears as the equivalent to one quarter wheat, it follows of necessity that nominal prices, whether high or low, would not increase or decrease his receipts or expenditure, nor his average gains or losses. Thus, so far, the various divisions of labour within any one State would never be affected in reciprocal interchanges with each other by alteration in the nominal cost of services, so long as the alteration in cost was a general one within the State, and governed solely by local natural conditions. But a different result would follow, so far as the shoemaker is concerned, if manufactured boots and shoes were largely introduced from a country where nominal money prices were generally much lower, or where the average breadwinners of the population—reduced to a perilous condition—were forced to increase their expenditure of daily effort relative to the standard of cost of one quarter of wheat to 89 hours, or $7\frac{5}{12}$ days labour of 12 hours per day. The local shoemaker would not have the advantage of distance and cost of transit, as in the case of the local quarryman or coal miner, for shoes and boots can be transferred long distances at a relatively small cost, and hence, if not protected in some other way, the local shoemaker would be unable to compete with the foreign low-paid worker. Not only would he have to increase his efforts to the same extent as the foreign competitor, but, were it not impossible, he would have to *exceed* his efforts before he could drive the foreign competitor from the field; failing this he would be reduced perhaps to half-time employment at the foreign rate of wages, and, probably, soon he and his family, overwhelmed with poverty, would become local victims to competition; and instead of being a help to the State would become dependants upon the rest of the breadwinners, thus increasing their State burdens.

It is usual with theorists to talk lightly of the *mobility* of labour under such circumstances, and to show that the local shoemaker, finding himself unable to compete in his capacity as shoemaker, would at once transfer his services to some other branch of labour, where it is supposed by theorists that there is always some providential provision. But all such writers do not seem to be aware that in a country where manufacturing industries do not dominate, there is a tendency to narrow the scope of operations, and to close more and more the doors of entrance to the remaining branches of active industries in proportion to the number of local industries actually driven out of existence by the influx of foreign manufactures. This is undoubted so far as the local market is concerned. No one can affirm with reason that an industry driven out does not correspondingly delimit the demand upon the *local market*. Logically, therefore, the only direction in which our shoemaker could maintain his existence as a breadwinner would be (1.) To convert himself into a labourer in raw products, for which there is still a profitable demand in *foreign markets*. (2.) Transport himself and his family to a country where his particular services are in demand, or (3.) Starve or become dependent paupers supported by the local State, already too heavily burdened by Poor Rates, etc.

In theoretical discussion this case would be disposed of by wordy wrangling, or special pleading; indictment of the capacity or lack of reasoning power of opponents; references to alleged harmonies of competition; and to dogmas and general conclusions of various Political Economists of accepted authority.

The usual ruts of controversy may afford ample opportunities for theorists to display literary skill, aided by the usual handy assortment of stock illustrations. But instead of a literary sham-fight, let the theorist enter into the real difficulties by discussing the matter practically with the distressed shoemaker. For this purpose we will take a common incident in these colonies.

A DEPUTATION FROM THE SHOEMAKERS DRIVEN OUT OF EMPLOYMENT BY COMPETITION WITH CHEAP FOREIGN MANUFACTURES.

Shoemaker, Spokesman for Deputation. *Theorist*, representing the Government.

Shoemaker.—On behalf of myself and my distressed fellow-workmen and their families, I have been asked to represent to the Government the terrible distress into which we have fallen by the influx of manufactures of boots and shoes from Europe at such low prices that we have not only been knocked off employment by local manufacturers, who were unable to compete with foreign houses, but we find that as individual workmen, with such high ruling rates in rent, clothing, and other necessaries, besides a high local taxation, we are unable to earn enough to maintain ourselves and families—even if we were able to get *full employment* at the foreign selling prices.

Theorist.—I sympathise deeply with your distress, but we cannot interfere with the laws of free interchange. You must therefore seek employment in some other way.

Shoemaker.—But we cannot turn our hands to another trade, and even if we tried, we would have to spend years as apprentices. Even in our own trade we had as young men to spend three or four years as apprentices, partly or wholly supported the while by our parents. Now we have no such help. On the contrary, we are each burdened with the support of a family. Even if we could manage for ourselves, what is to become of our families in the meantime?

Theorist.—I admit this difficulty, but is there not plenty of work open to you in this country, where you could turn your labour to account where no special skill is required, or, at any rate, where bone and muscle is all that is necessary.

Shoemaker.—True, in time some of us might obtain work as labourers in the field among farmers, or on public works or mines; but the failure in our own industry, in such a thinly populated country, causes a depression in nearly all local occupations; for it must be admitted a considerable portion of the products of other trades and industries have been directly affected by our distress and lessened consumption due to our lack of purchasing power. Besides, I have been told by farmers that they have themselves long struggled with adverse circumstances in competing against more favoured agriculturists in America—who are able to sell in European markets—our only customers—at prices which tend to become lower year by year, and if a local market is not soon established, many of them will have to give in. If other trades in turn are crushed by foreign competition as we have been, what hope have the farmers of holding on, let alone the outlook for their own children, where every branch of industry seems to be already overstocked, even in this rich and extensive country, with a sparse population. In addition to what I have stated, I am informed by those who have given much attention to agriculture, that there is only a limited amount of land whereon agriculture might be successfully carried on, but this form of industry will not admit of the employment of more than 35 persons to the square mile of land in cultivation; and if this be so, and if farmers cannot exchange products of the same kind with each other, how can a local market become a possibility in the absence of a local community of trades and manufactures?

Theorist.—I admit that the home-trader and home-workman may *temporarily suffer loss* from the competition of foreign traders and workmen in the same branch of industry; but it must be remembered that *everything* will again be adjusted, because capital is constantly exerting a tendency to *smoothe down* any *temporary inequality* in the profits of different trades. Even if you suffer from foreign importations the Government is not bound to protect you: for there can be *no right* which has a juster claim than that every individual of the community should be freely permitted to obtain commodities where he can buy them on the cheapest terms, and to sell them where he can realise the highest price.

Shoemaker.—It is easy for theorists to write such things. I am unable to understand exactly what you mean by suffering a *temporary loss*, or what the process may be which you euphoniously term a tendency to *smoothe down any temporary inequality.* I and my fellow-workmen are now unemployed. Many of us with our families are in great distress. Without *instant employment or relief from some source many of us will die of starvation.* We have no means, and if we had we do not know where to go to better our miserable condition. Do you mean if many of us succumb and die from want and misery, thereby thinning our own ranks as competitors for the existing small field of employment still remaining—that *this is the smoothing down process* to which we are referred for comfort. Good Heavens, surely not this? Remember that we are human beings, not machines! The machine may stand idle for a time and live; men cannot. Friction in inanimate machinery means dissipation of power in heat. With men friction means distress, misery, and death. Men are not machines, and loose analogies based upon the laws of physical processes cannot be grimly applied to men fighting for life and exposed to suffering. You say that Government is not bound to protect its own workmen, and that there can be no right having a juster claim than that every individual should have the most absolute freedom in buying in the cheapest market and selling in the dearest, irrespective of any local claims of sympathy, or national or racial ties of common interest. Such a commercial law, not bond, cannot be consistent with the conditions which necessitate the maintenance, defence, and independence of disconnected individual nationalities. To be logical, it would necessitate the breaking down of all individual States, all individual race conglomerations, and the fusing of all human elements into one grand State of the world. Until that time arrives there must of necessity be localised interests governed by the same local general conditions which maintain separate nationalities. All the social organisations of the State, such as Railways, Roads, Bridges, Harbours, Post and Telegraph, Schools, Defence and Protection, Poor Laws, etc., can only be logically maintained upon the admitted necessity of some common local national interest, having special concern for the general welfare of the particular nation; and these special local interests are so intertwined by so many bonds more precious than mere questions regarding *absolute cost of products in money*, that it seems absurd to say that the destruction or suffering of any of its members are locally only of equal concern to a corresponding evil in a foreign state similarly constituted. The necessary gravitation and concentration of interests and sympathies around home and fatherland are as natural as perspective in optics; the greatest density must be near the centre of—self, home and family—becoming weaker and weaker as the relative rings of friends or relations, club, townsmen, nation, race, are passed through to the thinner sympathies lying beyond, embracing humanity generally, where foreign races and states are bound in; and they themselves are related obversely to us in a similarly graduated series of interests and sympathies. It is this grand gravitation of human interests and sympathies which make possible ideas and forces, which make home, friend, and fatherland; and these—not nominal cost of products—are the great factors which determine the energies and welfare of any community. Commercial laws tend to destroy the heart of all ideas which centre in home and fatherland, and if the nation is to live, it must carefully guard against its decrepitating influence. Its shuttle seems just as ready to weave the shroud of a nation as to bind nations in bonds of broader sympathies.

DOMINATING WANTS DETERMINE OCCUPATIONS AND NECESSARILY PRODUCE INEQUALITIES IN THE FORM OF SERVICES.

Hitherto in the writings of Social Reformers the greater part of their attention has been confined to the monopoly by the poor of the lands, houses, railways, and other instruments connected with the production, security and distribution of the necessary wants of human beings. It is generally assumed that there is abundance of primary satisfactions for each one if the aggregate products annually created were more equitably distributed. But if even the necessary primary satisfactions were annually produced in sufficient quantity for the wants of all, it would go to prove the curious and inexplicable circumstance that the present haphazard training and supply and demand of those who are engaged, or who are being trained to engage in the various divisions of labour, are in perfect harmony with conditions which combine to effect a result which might seem too formidable if undertaken by the most absolute regulations of intelligent prevision. The present supply of satisfactions is determined by the estimates or combined action of self-interested producers. It cannot be affirmed on the basis of *producers' self-interest*, that wants are produced with the sole idea of providing the highest quota of satisfactions to each individual; at best they favour the *minimum* supply, as self-interest is best rewarded by a keen demand involving high prices; a result which would not be attained if the *maximum* quota of satisfactions for each individual was created. Of course the absence of a perfect scheme of combined prevision among producing competitors, and the unforeseen variable effects springing from natural causes year by year, often produce abundance, or superfluity, or over-production, as it is termed; but this is a result not premeditated, and although favourable to consumers for the time being, it is a mere accident causing a fall in prices, and is likely to be followed by purposeful under-production during the succeeding period, in order to produce a straitened market with a corresponding rise in prices, and results in a certain reduction of the ideal quantity of satisfactions falling to the lot of each consumer of the poorer classes. But this tendency of *self-interested* producers, striving to produce *under* the necessary requirement, is just the very condition for involving the poor in the continual battle with poverty and want;* and all that can be said in favour of self-interest, is that hitherto there has been no better method devised which would so effectually serve the *majority* of human beings.

Is it to be wondered, then, that the *less fit*—happily a minority—in the struggle for existence should at times cruelly feel pinching want, when upon them must fall the evil of the barely sufficing aggregate or scarcity, the ideal creation which the self-interested producer strives for?

It has been shown that the supply of wants is at present alone roughly predetermined by the self-interested calculations of producers, and that their aim is to extend the field of production as far as they can in safety to themselves; and that means as near an approach to a full supply as will ensure good prices, involving a tight market, or scarcity. Consumers who desire abundance do not determine the forthcoming supplies. Producers' interests, therefore, are antagonistic to any social ideal which would bring the highest quota of necessary satisfactions easily within the reach of all men. Therefore, so long as producers' self-interest rules supreme in the creation of necessary products, so long must we expect the periodic suffering and pinching of the lower stratum of the working classes.

Food, clothing, houses, railways, steamboats, and the various machines of production, are almost wholly regulated in the interests of producers; competition alone preventing this interest from working in too great antagonism to the interests of *consumers*. Nearly all breadwinners, therefore, in detail defeat to some extent their own ultimate interests as general consumers, by regulating the production of supplies upon a principle which is inimical to their interests as consumers. Nor is this the only evil. All wages—breadwinners must produce, or serve to produce, before they can earn the right to share or consume the fruits of production. But the *number of those actually employed* depend almost wholly upon the *self-interest* of the *large capitalist producers.*

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* Bastiat even is forced to admit that "antagonistic desires cannot at one and the same time coincide with the general good." . . . . . "As a purchaser he desires abundance; as a seller scarcity . . the wishes and desires of the *consumers* are those which are in harmony with public interest."

It is not the interest of large capitalist producers to provide the full quota of wage-earning employment to *all* breadwinners. The larger the number of fully employed labourers the keener is the demand for products, and indirectly this may have some influence upon certain producers. But this indirect consideration is too feeble to interest producers in any scheme for the general good which might be directed to ensure full employment to *all* breadwinners. It is manifest, therefore, that in the present scheme of the division of labour there are two ugly defects. *First*—There is no interest intelligently organised to train and determine the occupations of the future breadwinners according to natural proportions. *Second*—The only existing agencies which determine the extent of employment are guided by a principle which has for its object neither the supply of the highest quota of satisfaction to consumers, nor the more needful provision for securing employment to all breadwinners. In the latter case competition, instead of befriending the wage-earner and dependants as consumers, operates all the more harshly upon the larger number who are handicapped in the race by aimless training, or no training, for the nature of services that might possibly be otherwise open to some of them.

UTOPIAN SCHEMES OF SOCIALISTS.

It is not a matter for surprise, therefore, that the mass of wage-earners should readily sympathise with every vague Utopian scheme of the Socialists, which holds out, however faultily, some promise or plan for dealing more effectually with the root difficulties which affect them most nearly, viz., security of employment; protection from over competition; shorter hours labour with more adequate remuneration; redistribution of wealth, etc., etc.

But it is needless to point out that before the redistribution of the aggregate of all forms of existing wealth of exchange (so-called) can be dealt with, it must be clear that this wealth consists of such forms as might effectually satisfy all the primary wants and comfort of human beings. That existing *wealth in exchange*, even if equally distributed, would fulfil this most necessary provision, is a pure assumption.

It has already been shown that a great part of the existing nominal wealth of exchange, largely owned by the rich, consists of the mere *tools* and *instruments* of production, and that the real wealth, appropriated as consumable wealth or primary satisfaction, is already more widely and evenly distributed than is generally supposed. Even under the most thorough Socialistic scheme this form of wealth would be far less generally distributed than at present; for, according to such a scheme, it would be wholly reserved in the hands of the Executive Government. It is utterly misleading to reckon upon the existing wealth of capitalists as a source for raising the quota of the real consumable and primary satisfactions. The only distribution possible in this respect would be the empty idea of part ownership. It is the increase to necessary current productions *designed for actual consumption* — material satisfactions — which alone can raise the average standard of primary satisfactions, and so dispose of material want, or poverty, and distress. The question therefore arises. Suppose that such a scheme were practicable, would the producing energies of men be greater and more effective than under the Scheme of Competition, Liberty, Right of Inheritance, Property Right, or Individualism, as it is called? To be more effective in one essential it must utterly fail in the other. The workers must be trained and allocated to specific occupations in strict conformity to the amount and nature of the labour actually required to produce the primary satisfactions and comforts desired. Training for every specific occupation requires considerable time; but for the occupations of skill a large amount of time must be consumed in acquiring the necessary training, irrespective of question with regard to the unequal distribution of capacity.

Now on the basis of equality it may be easy to divide products; that, according to actual needs is simple enough, involving no insuperable difficulty. But what about the allocation to different employment? How can the easy, the refined, and the skilled occupations be allocated on any scheme of equality? The majority must, as heretofore, sweat at the hard and dirty forms of labour. But what power, or what plan can be devised which will enable any elective executive to doom once and for ever the majority of learners and workers to the hard and irksome occupations, and to fix the minority in the refined, the easy, and skilled services?

Suppose it were for a time instituted, how long would the unfortunate majority be content to submit to their lot before an irresistible cry for *redistribution of occupations* arose; and if it arose, where is the force stronger than the majority of freemen to prevent the breakdown of the social organisation necessary to produce the supply of primary satisfactions according to individual needs? What compensation can be given to the masses toiling in the more wearisome occupations? Extra allowance of satisfactions cannot be thought of, for that would destroy the coveted ideal of equality in the distribution of satisfactions according to needs. Shorter hours cannot be allowed without trenching upon equality of leisure.

The unequal distribution of natural capacity, and the time necessary to acquire knowledge of more than one technical branch of skilled employment, make it impossible to share in turn for a time all possible forms of labour. In short, the practical difficulties standing in the way of *equality* in the *allocation of employments* appear to be insuperable, and would most certainly, if there were no other objection, destroy any social organisation on a *large scale* which had been courageous enough to attempt it. Reference to simple communities—as in America—following agricultural pursuits mainly, and not of themselves fulfilling for themselves the whole round of human wants, are utterly misleading. Such small communities are composed of a peculiar select class, who voluntarily bind themselves to a more or less ascetic life, and all such partial attempts tend to perish from lack of internal vitality. With a large mixed body of men embracing all occupations and endowed with ordinary passions and desires, the results would be chaotic and disastrous in the extreme.

One effect, terrible to contemplate, would seem to be inevitable, viz., that the indiscriminate distribution of products among all men would destroy the major source of savings at present so largely devoted to the creation and maintenance of the powerful and costly auxiliary aids to human labour; and the slight individual gain per head in material satisfaction would only be of a very temporary character, for it would soon be lost by the new impulse given to the improvident to rapidly increase their numbers.

WHAT WOULD BE THE PROBABLE EFFECT UPON SOCIAL WELL-BEING IF THE MAJOR SOURCE OF SAVINGS WERE DESTROYED?

In another place it has been indicated that the mere "two-hands," or the unaided labour of man, would not only fail to produce the average comforts and luxuries now enjoyed by nearly all classes of men, but more calamitous still—they would fail to produce the *prime necessaries* of life in sufficient quantity to maintain the lives of the existing population. Defects in the existing scheme of civilisation—some of which seem to be ineradicable—may be truly charged yearly with the destruction of thousands of valuable lives, but were the present major source of savings dissipated or destroyed by equality in share of earnings—either by lowering the powers of production, or by *slightly raising temporarily* the average amount of satisfactions *consumed or enjoyed*—the new conditions (equality of earnings) would be a blight and a curse; for while the existing defects in distribution may be the cause of the misery and destruction of thousands of valuable lives, the *equality* scheme would certainly entail the misery and destruction of millions now living in a state of comparative comfort.

Many who fail to ponder upon these root difficulties may exclaim:—How can you explain this paradox? Why should the fairer distribution of wealth (that according to actual, individual needs, without regard to inequalities of natural powers, capacities or inheritance,)—raising the average comfort of the majority, and lowering the superfluous and luxurious satisfactions of the minority—be productive of such disaster? The answer is plain enough. The power to effect large savings or to create the more costly auxiliaries of labour depends mainly upon the existence of specially favourable conditions.

1. The desire to accumulate or save can only become strong enough to be effective when the stronger desires for primary satisfactions are appeased.

2. Savings or accumulations, therefore, can never be produced by labourers or others whose earnings do not exceed the supply necessary to satisfy the three primary wants. The majority of breadwinners are always in this hand to mouth condition, and rarely of themselves are able to contribute to the maintenance and increase of machines and instruments to serve as auxiliaries of production to future labour. They, however, in their social relations more than contribute the average share of the future surplus workers whose efforts must be proportionately supplemented by capital and power-multiplying instruments, if they are to enjoy the same or a further improved condition.

Those workers whose earnings are sufficient to provide comforts beyond the limits of bare prime necessaries, may, however, by self-denial in the satisfactions of *comforts*, lay by a small store of savings, which in time may swell into such valuable auxiliaries to earnings, that the self-denial in *comforts* hitherto may be rewarded in the greater satisfaction of comforts in the future, and even add considerably to the store of wealth which may be converted into the more permanent capitalised auxiliary instruments of power which will benefit the generations coming after them.

Those, however, who contribute most largely to the creation of the permanent instruments which add unknown power to the efforts of hand labour, are chiefly those who either have inherited these or similar creations from their ancestors, or who by extraordinary energy, skill or self-denial, or all together, in the earlier part of their lives, are now enabled, after satisfying the three primary wants and comforts, to indulge the prevailing passion of comfortable people, *i.e.*, the accumulation of wealth or power over wealth. This passion in itself is at this stage undoubtedly a personal luxury; but, unlike the luxuries which are directed to greater *personal consumption*, it is fortunately directed to that form of immaterial enjoyment which springs from the knowledge that the owner possesses the power to direct the mode, or secure the best conditions in which wealth may be further employed. Fortunately for the world at large, self-interest at this stage converts into a virtue what otherwise would be a vice: for the passion to further secure the luxury of power over wealth, and to augment it, restricts personal indulgence in further consuming the *material fruits of labour and the material gratuitous stores of nature*, and runs parallel with that course which favours increased production relative to numbers, involving the improvement of the social and economic condition of all labourers; *i.e.*, the wealthy man or industrial chief does not, or cannot, increase his own personal consumption of the *material* fruits of labour, skill, enterprise and the gratuitous gifts of nature beyond a moderate standard: the unconsumed material surplus—by passion, self-interest and even the better motives—is necessarily devoted to multiplying and sustaining the inanimate, costly, and powerful permanent aids to human productive power, which alone distinguishes civilised populous communities from those of the miserable and bare-handed savage, whose command of a continent of the richest land upon the globe is too feeble to support in comfort a few insignificant wandering tribes.

ANTERIOR SAVINGS THE TRUE SOURCE OF CAPITAL INVESTED IN THE CREATION AND DISTRIBUTION OF NECESSARY SATISFACTIONS.

Capital invested in land, railways, ships, canals, mines, mills, etc., and all labour-aiding machines and instruments devoted to the production and distribution of man's satisfactions, are the fruits of that portion of the products of *anterior labour* saved from the actual earners' consumption, and devoted or transformed into permanent and powerful skilled auxiliaries of *present labour*; and consequently it is an error to assume, as many do, that such forms of capital are the fruits of the major part of *anterior labour* already absorbed in current personal consumption.

That is—the capital in machines and instruments now devoted to production and distribution is derived from the *saved* products of anterior labour engaged in production, and not from the efforts of such labour necessarily absorbed in sustaining the said labourers. It is true in one sense that all products, whether saved, transformed, or consumed, are obtained by means of labour; but it is equally true that only a minor portion of the products of labour is yearly devoted to fixed instruments to act as auxiliaries to future labour; and this minor portion is *wholly* derived from products of labour and skill *saved* from immediate destruction or consumption, and skilfully applied or directed to the creation of fresh auxiliaries to labour.

It follows from these considerations that existing capital so applied is *wholly* derived from *providential savings and skill,* and that only labourers who have contributed to these savings—with their natural representatives (inheritance)—have any real claim to a corresponding right to its *present* utilities and fruits.

Savings may be effected in various ways. They may be effected by greater industry: by the devotion of former savings to appliances aiding production: by increase of skill; by curtailing enjoyment in the consumption of satisfactions beyond *primary needs* or by a combination of all these: thus:—

Let I = Industry or energy expended.
K = Skill.
A = Skilled appliances or aids, the fruit of anterior providential savings.
C = Actual current consumption.
S = Current savings.

Then $I\ K\ A - C = S$ or current savings.

So long as C or current consumption absorbs all the powers of I K A there can be no savings. When C exceeds I K A, debt, pauperism, crime, or death, may be the result.

When I K A exceeds C there must be prosperity and augmentation of the powers for producing more wealth.

The maximum savings are effected when I K A are at the maximum (^{m}) and C is at the minimum (^{u}) necessary to secure the satisfaction of primary wants: thus:—

$I^{m}\ K^{m}\ A^{m} - C^{u} =$ Maximum of savings.

But if the power of C to waste, destroy, or consume the results of I K A be indefinitely increased say to (^{x}) power there may be no balance or savings: thus:—

$I^{m}\ K^{m}\ A^{m} - C^{x} = O$ Savings.

That is, the stage of no savings is produced by the absorption or consumption of a very great amount of luxurious satisfactions.

But this state of *no savings*, or the minimum of savings, may be and is more frequently the result of the diminished (^{n}) powers of I K A with the minimum of C, or minimum stage.

$I^n K^n A^n - C^n = O$ Savings.

We have here four or five important conditions affecting the appropriation of the fruits of industry, skill, and skilled auxiliary appliances and aids.

(1) $I^m K^m A^m - C^n =$ Minimum of satisfactions and maximum of savings.

$I^n K^n A^m - C^n$ (2) or $I^m K^m A^m - C^x =$ Maximum of satisfactions and no savings.

(3) $I^m K^m A^n - C^n =$ Minimum of satisfactions and increase of savings.

(4) $I^m K^m A^n - C^m =$
(5) $I^n K^u A^n - C^n =$ No savings, and poverty.

The first group is composed almost entirely of rich capitalists possessing skill, energy, and living moderately or abstemiously.

The second group is composed of rich capitalists possessing skill and energy, but living in extravagance.

The third group is composed of skilled minds and hands, middlemen, professional men, and better class of skilled labourers living moderately within their means.

The fourth group, the same as the last, but living up to their means, or lacking skill or energy.

The fifth group is composed of unskilled workmen lacking industry or lacking employment, or skilled workmen lacking energy or employment, or improvident in their manner of living.

Whatever defects spring from riches there is this to be said in its favour: that by passion for accumulation or savings of its owners it secures the necessary fund to invest in the expensive tools and instruments of production, without which the primary wants of the existing population could not be supplied. The desire to sacrifice present ease to future benefit is confined to the few, and if the products were generally distributed in equal proportion they would be almost entirely lost by slightly raising for the moment the average consumption of satisfactions; and this slight advantage would soon be dissipated by the impulse which it would give to the masses of improvident persons—in heightening the marriage rate, and causing a rapid increase of population or mouths to be fed.

FALLACIES OF THE SINGLE TAX PANACEA.

Mr. Henry George's name among modern writers stands pre-eminent in the advocacy of the abolition of the existing modes of levying taxes mainly derived from land and property, luxuries, and foreign products, and substituting for the same a direct tax upon the value of the land,* minus such *tangible* artificial additions to its value that may be truly estimated as *improvements* solely created by the labour or services of man. Waiving the serious objection at the threshold of this proposal, viz., the difficulty—nay the impossibility—of justly determining the proportional values of the *land* and the *improvements* added to it by *man's services.* Let us examine it fairly in the light of the various CANONS OF TAXATION which Mr. George himself quotes with approval: Thus p. 63 (People's Edition) "Progress and Poverty," he affirms:—

"The best tax by which public revenues can be raised is evidently that which will closest conform to the following conditions:—

"1. That it bear as lightly as possible upon production so at least to check the increases of the general fund from which taxes must be paid and the community maintained.

"2. That it be *easily and cheaply collected and falls as directly* upon the ultimate taxpayers, so as to take from the people as little as possible in addition to what it yields the Government.

"3. That it be certain, so as to give the least opportunity for tyranny and corruption on the part of officials and the least *temptation to law-breaking* and evasion on the part of the taxpayers.

"4. That it *bear equally,* so as to give no citizen an advantage or put any at a disadvantage as compared with others."

THE EFFECT OF THE SINGLE LAND TAX UPON PRODUCTION.

Mr. George asserts without the slightest attempt to show by argument or demonstration that "Taxes on the value of land not only do not check production, as do most other taxes, but they tend to increase production by destroying speculative rent." This, certainly, is one of the most absurd and fallacious assumptions that could be made, and yet, without reason or argument, Mr. George supposes that we can at once build upon this rotten foundation without question or hesitation. He evidently thinks that different *names* for the same thing have some occult power to alter the inevitable effects due to the thing *per se*, and not to the name applied to it. This is the fault of all visionary theorists. Let us brush away the thimble-rig of words and terms, and come at once to plain practical issues. No person can become a successful primary producer among other primary producer-competitors, unless he possesses the necessary capital and speculative skill. There is no business so uncertain in its results as farming, both as regards total income and total expenditure. More especially do these uncertainties apply to the enterprising farmer, who ventures into the speculation of entering upon virgin bush land with the view of earning a living for himself and his family ultimately from the profits derived from the sales of cultivated *products*. This profit consists entirely of the margin which the aggregate of his yearly *revenue* from sale of products shows above the aggregate of his yearly *expenditure.* It is the *amount* of the several items of *revenue* and *expenditure* which determines his *profit* or his *loss*, and not the specific nature of the various items of *revenue* and *expenditure.*

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* That means in practice a tax upon local products in lieu of a tax upon foreign products.

All items of expense, including profit, must come out of products, or he will speedily become bankrupt and cease to be a producer. Consequently, all products embody *all charges*, whether interest, mortgage, rent, tax, wages, other working expenses, and cost of farmer's own services as director and speculator, viz., *profit.*

RENT VERSUS SINGLE TAX.

Rent adjusts itself to the producing capabilities of the land. But a single national tax upon the land would be likely to prove a more formidable check to the cultivation of the soil or local production than the most heavy form of rent.

Rent is admittedly determined by the average margin left from the *sale* of products, after giving the working expenses of the farm *plus* the minimum profit to the working farmer. It cannot seriously affect production without destroying itself, and hence it must accommodate itself to the said margin, even though it should fall to rent zero. The latter stage, if reached, might check production, but so long as any margin remained production would be determined by the capabilities of the land and the enterprise and skill of the farmer. There is, therefore, no predetermined charge *fixed in character*, forming a charge on production in the shape of rent. On the contrary, it fluctuates in time in correspondence with the revenue yielded from the sale of its products. Rent rising, with relative improvement, either in price of products or with relative decrease in the cost of working the farm, due to improved machines or methods of cultivation; rent falling with the reverse of these conditions. On the whole, therefore, rent, interest, mortgage, and working farmers' share of profit resolve themselves into mere sub-divisions of the total profit due to farm speculations drawn from sale of products, the balance of sale of products being absorbed by wages and miscellaneous expenses of working, all entirely governed by, and not exceeding, the total revenue of products, the amount of which is regulated by the local competition of similar goods that may be conveyed in any market from foreign as well as local sources. It is absurd, therefore, to suppose that a *tax* upon land does not enter into the ultimate cost of the product just as surely as the items of charge known under the names of interest, mortgage, wages of farm servants, profit of farmer; for as soon as the prices governed by local and foreign competition fail to cover *all* the items of expenditure and minimum of profit, so soon will a *check* appear to Production, so far as the land which is so effected is concerned. There is no trick of words about this result. Every practical farmer knows it too well, although he may not understand the word-splitting and theory-chopping of some speculative Economists. Thus, with average energy and skill, if the produce per year of a grain farm at current prices only covers the minimum of wages and ordinary working expenses, and minimum of profit to farmer by £50, then such farm could only yield that sum for all other charges, whether tax, rent, mortgage, or interest. It is immaterial to the farmer whether the charges be distributed over all these items thus:—

	£	s.
Tax	12	10
Rent	12	10
Mortgage	12	10
Interest	12	10
Total	£50	0

Or simply thus:—

	£
Tax	50
Rent	*nil*
Mortgage	*nil*
Interest	*nil*
Total	£50

The effect upon production, producer, and consumer would be exactly the same. If this sum of £50 could be disposed of altogether it would be possible for the farmer to reduce to that extent the price of products to consumer, but the consumer must necessarily pay for it so long as it remains a charge either as tax, rent, interest, or mortgage. It is the *amount* remaining as a *charge* that concerns the producer and the consumer, and not the *nature* or *name* of the item forming the said charge.

So long, therefore, as foreign products are not artificially excluded from local markets the consumer is perfectly secure against the monopolists of local rents raising the price of products by arbitrary increases to rent.

But a very different conclusion must be arrived at if rental and other charges, such as interest or mortgage, are abolished, and merged in the shape of a single tax upon land. In the first place, if we abolish all burdens on land in the shape of rent or mortgage—How are we to do so? In these colonies at least, the right to the rent of land has been acquired by honest purchase. Even now the State in Tasmania derived (in the year 1888) a revenue of £77,504 from rental and fresh sales of land; a sum equivalent to 19·09 or nearly 20 per cent. of the total yearly taxation. In the 10 years ending 1888 the State derived a revenue of £646,497 from the same source: and yet after taking from honest purchasers this original value of the land, Mr. Henry George and his followers would urge upon the State to retain the original purchasers' money, and wrest from them all rights in land thus acquired without compensation. Such a proceeding would be revolting to all who possess any remaining trace of the sense of honour. The hypocrisy of glossing over such wholesale robbery by any fine-sounding phrase only shows how far the modern robber has fallen from his ancient prototype, who, at least, had the courage to consent to an appropriate name for his violence and dishonesty. We have no representatives of feudal lords in these colonies, and if we had, the proprietors of the land for the time being are as much and as little their representatives as any other capitalist; for every year a considerable portion of the land changes hands by fair purchase, and there are now few owners of land who can trace their land to the State by purchase or grant, who have not parted with it on fair terms of purchase to those who amassed wealth from other sources of wealth and enterprise. The condition of society, if it is to be improved, cannot be ameliorated by State robbery or violence. There is, therefore, only one honourable course for the Single Tax theorists to adopt, viz., to compensate the existing owners for the loss of their rightly acquired property. This course would involve capitalising the land. Now, supposing this to be done, and that we made some profit by borrowing, say, at 3½ per cent. (allowing that the revolutionary scheme has not the immediate effect of destroying our credit), what would be the sum to provide for?

The last estimate of private property is stated to be £21,386,848, and it will be near enough the mark to state that 40 per cent. of this value refers to land *minus* improvements. This represents a capital sum of £8,554,739. Even if we raised this sum at 3½ per cent. par, it would increase our existing charge for interest on debt by £299,415.

Single Tax fixed in character determined by the needs for public expenditure without regard to the capabilities of the land or to its power to sustain the burden so imposed.

But if we are to meet the demands of public expenditure we must concentrate all the other modes of raising revenue from taxes and land sales in one single tax or burden upon the land. At present the revenue raised in this way in Tasmania amounts to £455,027 *per year.* If to this we add the fresh charge for land transfer to the State, the tax upon land would be necessarily raised to £754,443. The present value of the annual rateable value, *minus* improvements, is estimated to be £440,800. It would therefore follow that the direct burden upon land would be raised £313,643 *per year*, or 71 per cent. above the burden now imposed upon it by way of rent; or if we take the land and improvements, it would mean an increase of 28·45 *per cent.* on land and its improvements above the burden at present imposed due to rental. It is true there would be some set-off to this in the abolition of other forms of taxation, at present mainly derived from the luxurious consumption of spirits and tobacco, etc., averaging £2 16s. 2d. *per head* per year, or £6 5s. 8d. per *breadwinner*, £11 4s. 8d. per family of four persons, or £14 13s. 10d. per *household.*

But it must be borne in mind that at present the taxes actually paid by any one individual, by an inevitable law, is adjusted to the means of the individual. For example, the large part of the necessaries of a poor man is not taxed—bread, meat, vegetables, and such like—and even on the taxable articles the amount of tax is proportionate to the amount the individual is enabled to expend upon taxable articles, principally drink and tobacco. A non-drinker and non-tobacco smoker, therefore, at his own pleasure, escapes the greater part of the State tax. In this way any person, by the present mode of taxes, need in case of distress, pay only a very small portion of his income in taxes.

But in the case of a single tax upon land (ground rent) the poor man in a four-roomed weatherboard hut might have to *pay the same* amount of tax as his rich neighbour in a fine house. Thus take the following possible cases:—

	Capital Value		Annual Rent of House	The same as affected by Land Tax		Annual Rent of House	Increase.	Per Cent.
	Land	House		Land	House			
.	£	£	£	£	£	£	£	
A	200	2,000	110	342	2,000	117	7	6·3
B	200	1,500	85	342	1,500	92	7	8·2
C	200	1,200	70	342	1,200	77	7	10·
D	200	1,000	60	342	1,000	67	7	11·6
	200	500	35	342	500	42	7	20·
F	200	300	25	342	300	32	7	28·
G	200	200	20	342	200	27	7	35·

Land 40ft. frontage on street same Block.

Thus, if the total rental be a fair index to the means of each tenant, the table shows that the effect of the single tax in adding £7 alike to rich and poor, would be only a relative tax to the rich (*a*) of 6 per cent., while to the poor (*g*) it would be equal to an increase of 35 per cent. Thus it would appear that the single tax would violate the most valuable canon of taxation, —8, (Adam Smith.) "The subjects of every State ought to contribute towards the support of the Government as nearly as possible in proportion to their respective abilities." When we consider also that if the farmer is able to add the increased burden of 28·45 per cent. to his products (and if he fails by foreign competition to do this, he can no longer carry on the farming industry in Tasmania), we must also add 28·45 per cent. to all products of Tasmania which the poor man's family consumes, we perceive at once that *the single tax scheme would mainly fall with cruel severity upon the poor man,* and thus the scheme instead of a boon would be a curse to him, and perhaps check half or most of our great producing industries. If our principal industries were checked it would operate at once in throwing a great part of the population out of employment. Even if it only curtailed a labourer's employment by 10 per cent. it would have the effect of reducing his wages (at 6s. per day) by 0·92 pence, nearly a 1d. per hour: while if the whole land rental were directly distributed among workmen yearly it would only have the effect of raising their wages by 0·679*d.* or only *2-3rds of a penny per hour.*

As regards the supposed effect of decreasing the cost of collecting revenue, and preventing fraud, it would have the opposite effect. Collection by Customs in Tasmania only represents 2·8 *per cent.* of the total revenue collected, as against a charge of 5 *per cent.* for collection of Real Estate Duties and Police Rate.

Thus the whole of the canons of taxation cited by Mr. George would *be violated by any single* tax proposal.

FURTHER OBSERVATIONS UPON THE FISHES AND FISHING INDUSTRIES OF TASMANIA, TOGETHER WITH A REVISED LIST OF INDIGENOUS SPECIES.

By Robt. M. Johnston, F.L.S.

It is now about eight years since my first Catalogue of the Fishes of Tasmania was presented by me to the members of this Society. Since that time I have occasionally published an account of other species not embraced in my original list. Messrs. A. Morton, F.L.S., and Saville-Kent, F.L.S., have also made two or three interesting contributions, and have added considerably to our knowledge of the indigenous fishes of the island. In this way the 188 species then known have increased to 214 species. As it is desirable that a fresh catalogue should be prepared, embracing all the species known at the present time, I have much pleasure in submitting the following additional observations regarding our fishes and fishing industries, together with a list of the principal edible fishes, and a complete classified list of all the fishes known to me at the present time.

The Tasmanian student has now also the great advantage of reference to the splendid "Catalogue of Australian Fishes," prepared by the Hon. William Macleay, to whom the author acknowledges himself greatly indebted for valuable guidance and information.

FISHES.

The known sea and inland fishes of Tasmania, including the eight species of European fresh-water fishes successfully acclimatised, number 214 species. These are generally grouped by naturalists under 4 sub-classes, 65 families, and 146 genera. About one-third of the number stated may be considered good edible fish, although only about 21 species are caught in sufficient number to form a market supply. The following are the local names of those found in greatest abundance, the first six alone forming articles of export[*]:—The Hobart Trumpeter, Perch *(Chilodactylus)*, Snotgall Trevally, Barracouta, Kingfish, Conger Eel, Native Salmon,

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[*] For further particulars regarding Natural History and Classification, see Report of the Tasmanian Fisheries Commission, 152 pp., 1882; and General and Critical Observations on the Fishes of Tasmania, with a Classified Catalogue of all the Known Species, by the Author (Proc. Roy. Soc. of Tasmania, 1882).

Bastard Trumpeter, Red Perch, Rock Gurnet, Flathead, Horse Mackerel, Sea Mullet, Rock Cod, Ling, Flounder, Sole, Garfish, Common Eel.

The first of these, the Hobart Trumpeter, is undoubtedly the king of Tasmanian Fishes, and is generally esteemed as the finest of the Australian edible fishes. It commands a high price and ready sale in the local market as well as in the neighbouring colonies; but, unfortunately, although captured in considerable numbers all the year round, it is very limited in its distribution, being confined to certain coral reefs or banks 10 to 70 fathoms deep fringing the southern coasts of Tasmania between Granville Harbour in the west and Seymour in the east.

The Barracouta, Kingfish, and Rock Cod appear periodically in such vast numbers that frequently the supply is greatly in excess of local demand. Owing to the absence of proper fish-curing establishments, large quantities have, at times, been known to be wasted or merely utilised as manure.

It is known also that large schools of Sand-smelts, Sprats and Anchovies appear upon our coasts at regular seasons, but, for the reasons already mentioned, and because the fishermen lack the proper appliances in the shape of *Pilchard Seine* nets, no attempt hitherto has been made to open up an industry in this particular direction.

Trawl-nets have been tried on the coast, but without good result. Either the class of bottom fish is absent in our waters, or the proper grounds have yet to be discovered suited for this mode of capture.

Besides the fishes proper, the fishing industry is largely dependent upon the capture of a fine species of Crayfish *(Palinurus Edwardsii)*, which often weighs, when mature, from 6 to 7lbs. It is estimated that there are over 280 tons of this highly prized Crustacean brought to market yearly, including those exported to Victoria and New South Wales, but excluding those used for baiting purposes and those captured by Victorian boats. There is also a small Prawn taken in considerable quantities during the season in the River Tamar. They abound all round our coasts, but little attention has been devoted to them anywhere on the coast beyond the River Tamar.

Of Molluscs there is only one of any importance,—viz., the Common Mud Oyster. Although not now abundant, it is estimated by competent authorities that about 20 years ago the various beds yielded about 44,000 bags, or 22,000,000 oysters per year.

The destruction of these once prolific Oyster beds have engaged much attention. Although attributed generally to reckless unrestricted dredging, continued until the greater number of the beds were wholly destroyed, it is believed by some that natural causes were operating concurrently with the causes alleged. Attempts have recently been made to extend the cultivation of the Oyster in the old habitats with great promise of success. Natural conditions again seem to be working round in favour of the development of the Oyster. The prolific fall of Spat during the last two or three years in the natural beds at Cole's Bay and Little Swanport, and their rapid growth there, promise well for the future of the new centres where artificial beds are laid down, at Spring Bay and elsewhere.

The following is a more extended List of the Edible Fishes brought to market in more or less abundance, according to the kind and season:—

LIST OF THE PRINCIPAL EDIBLE FISHES IN TASMANIAN WATERS.

[a]Abundant all the year round.	[b]Abundant during the season.
[c]Common all the year round.	[d]Common during the season.
[e]Not uncommon ditto.	[f]Not uncommon ditto.

PERCIDÆ (Perch Family).

Anthias rasor	*Red Perch*[d]	Season, winter.
Lates colonorum	*Brackish Water Perch*[a]	Confined to Anson's River.
Arripis truttaceus	*Native Salmon*[a]	Periodically enter estuaries in schools.

SPARIDÆ (Bream Family).

Girella tricuspidata	*Black Bream*[d]	Season, October to March. C. Australis enters brackish water lagoons and mouths of rivers for spawning purposes.
" simplex	*The Sweep*[d]	
Chrysophrys Australis	*Silver Bream*[d]	

CIRRHITIDÆ (Trumpeter Family).

Chilodactylus Allporti	*Carp*[d]	Season, January to March.
" macropterus	*Perch*[a]	Height of season (mature), April to August.
" vizonarius	*Magpie Perch*[f]	
Latris hecateia	*Trumpeter*[a]	The most excellent of all Tasmanian fish. Sometimes reaches a weight of 60lbs.
" Forsteri	Silver Bastard[b]	Abundant during season, January to March Rivals the Real Trumpeter at this stage.
	Red Bastard[a]	Immature form ; good, but not equal to mature form.
Mendosoma Allporti	*Real Bastard*[e]	

SCORPÆNIDÆ (Gurnet Family).

Sebastes percoides	*Rock Gurnet*[c]	Found on the outer reefs.

TRICHIURIDÆ (Barracouta Family).

Lepidopus caudatus	*Frostfish*[f]	Caught at odd times—winter.
Thyrsites atun	*Barracouta*[b]	Important food fish. Caught in vast numbers, November to August.
" Solandri	*Kingfish*[b]	Season, December to June. Come and go in vast numbers, but disappear in some years altogether.

CARANGIDÆ (Horse Mackerel Family).

Trachurus trachurus	*Horse Mackerel*[b]	Season, Jan. to April.
Caranx Georgianus	*Silver Trevally*[b]	Enter Tamar and other rivers, midwinter.
Seriola grandis	*Tasmanian Yellow-tail*[b]	Abundant Northern Coast, March to April.
Neptonemus brama	*Snotgall*[b]	Season, March to April.
" dobula	*Mackerel Trevally*[b]	Ditto, entering estuaries in large schools.

CYTTIDÆ (Dory Family).

Cyttus Australis	*Bastard Dory*[d]	Enter estuaries in schools, but seldom captured.

TRACHINIDÆ (Whiting Family).

Uphritis Urvillii	*Sandy*[a]	Abundant in the River Jordan and East Coast rivers.
Sillago ciliata	*Whiting*[d]	One of the most delicious fishes in our estuaries.

COTTIDÆ (Flathead Family).

Platycephalus Bassensis	*Common Flathead*[a]	A very fine fish, though repulsive looking. Abundant on sandy bottoms.

ATHERINIDÆ (Silver Belly Family).

Atherina presbyteroides " hepsetoides " hepsetus " microstoma " Tamarensis	*Silver Bellies*	These little fishes are found everywhere in vast shoals. Although seldom exceeding 5 inches long, they form a delicious article of food. No trouble is taken to capture them for market.

MUGILIDÆ (Mullet Family).

Mugil cephalotus	*Sand Mullet*[d]	Excellent fish. Found on the northern and eastern coasts.
Agonostoma Forsteri	*Estuary Mullet*[a]	Caught chiefly by hand-rod, in large numbers.

LABRIDÆ (Parrot Fish Family).

Cossyphus cerulæus	*Blue Head*[a]	Abundant, and although good food, it is not brought to market.

GADOPSIDÆ (Blackfish Family).

Gadospis marmoratus	*Freshwater Blackfish*[a]	An excellent fish, peculiar to our northern rivers.

GADIDÆ (Cod Family).

Pseudophycis barbatus	*Rock Cod*[a]	Excellent fish, well suited for smoking. Very numerous during winter.

OPHIIDÆ (Ling Family).

Genypterus blacodes	*The Ling*[e]	Very fine fish.

PLEURONECTIDÆ (Flounder Family).

Rhombsolea monopus	*Flounder*[a]	Excellent table fish.
Amnotretis rostratus	*Sole*[e]	Abundant in some estuaries.

SALMONIDÆ (Salmon Family).

Retropinna Richardsoni	*Whitebait or Smelt*	Enters estuaries in large shoals. Though only 3 to 4 inches long, they are very delicious

Salmo salar	The Salmon	These valuable fishes have all been successfully introduced from the United Kingdom. The three last species are very abundant now in our rivers and seas. The Brown Trout sometimes reaches a weight of 32lbs.
" trutta	Sea Trout[b]	
" fario, *v.* Ansonii	Brown Trout[b]	
" fontinalis	American Trout[b]	

HAPLOCHITONIDÆ (Grayling Family).

Prototroctes maræna	*Cucumber Mullet*[b] *or Grayling*	This fine little fish is the most delicious of our freshwater fish. It is found abundantly in the Mersey and northern and western rivers. Affords excellent sport to anglers

GALAXIDÆ (Jolly-tail Family).

Galaxias truttaceus	*Spotted Trout*[a]	Small fish, very abundant in all our streams Excellent for the table and caught readily by rod and line
" attenuatus	*Jolly Tail*[a]	
" auratus	*Golden Trout*[e]	Largest form, Lake Sorell.

SCOMBRESOCIDÆ (Garfish Family).

Hemirhamphus intermedius	*Garfish*[b]	Excellent fish for the breakfast table. Season, April-October.

CLUPEIDÆ (Herring Family).

Engraulis encrasicholus	*Anchovy*[b]	Enters estuaries in large numbers during summer.
Clupea sprattus	*Sprat*[b]	Great shoals, Aug.-Nov.

No attempt has yet been made to utilise these valuable fishes, owing to the absence of appliances and to the lack of enterprise in the shape of fish-curing establishments.

MURÆNIDÆ (Eel Family).

Anguilla Australis	*Common Eel*[a]	No proper appliances exist for the capture of these valuable fish.
Conger vulgaris	*Conger*[a]	Valuable market fish, sometimes attains a weight of 40 lbs.

Sharks of various kinds are abundant, and although the smaller forms, such as Mustelus, are edible, they are not utilised as food.

Galeus canis (Dog Fish) is captured largely in certain localities, and the liver is boiled down for oil. The fishermen also largely use the flesh of "Gummies" and "Dog Fish" as bait for the deep-sea Trumpeter fishing.

The following is a classified synopsis of all the known Fishes of Tasmania, embracing 65 families, 146 genera, and 214 species:—

SYNOPSIS OF TASMANIAN FISHES OF ALL KINDS.

SUB-CLASS TELEOSTEI.

Family.	Genera.	Species.	Examples.
Percidæ	12	13	Red Perch, Native Salmon
Squamipinnes	1	1	Scorpis
Mullidæ	1	1	Red Mullet
Sparidæ	4	5	Bream, Schnapper
Hoplognathidæ	1	1	Hoplognathus
Cirrhitidæ	5	14	Carp, Perch, Trumpeter
Scorpænidæ	5	7	Gurnet, Soldier
Berycidæ	2	2	Nannegai
Kurtidæ	1	1	Pempheris
Sciænidæ	1	2	Maigre
Xiphiidæ	1	1	Swordfish
Trichiuridæ	2	4	Barracouta, Kingfish
Carangidæ	5	8	Horse Mackerel, Snotgall
Cyttidæ	2	2	Bastard Dory
Scombridæ	5	5	Mackerel, Pilotfish
Trachinidæ	5	6	Catfish, Whiting
Pediculati	1	2	Handfish
Cottidæ	3	5	Flathead, Flying Gurnard
Gobiidæ	2	2	Goby
Gobiesocidæ	1	1	Gobiesox
Blenniidæ	6	8	Blenny, Bully
Sphyrænidæ	2	2	Jack, Pike
Atherinidæ	2	6	Sand-smelt, Silver Belly
Mugilidæ	2	2	Mullet, Sand Mullet
Centriscidæ	1	1	Snipe, or Trumpet-fish
Gobiesocidæ	1	1	Crepidogaster
Lophotidæ	1	1	Lophotes
Trachypteridæ	2	2	Ribbon Fish
Pomacentridæ	1	1	Rock Perch
Labridæ	4	13	Blue Head Stranger, Parrot-fish
Gadopsidæ	1	1	Blackfish
Gadidæ	2	2	Rock Cod
Ophidiidæ	2	2	Ling
Macruridæ	2	2	Coryphæna
Pleuronectidæ	3	4	Sole, Flounder
Haplochitonidæ	2	2	Derwent Smelt, Freshwater Herring
Scopelidæ	1	1	Alepidosaurus
Salmonidæ	2	5	Salmon, Whitebait
Galaxidæ	1	5	Spotted Trout, Jolly-tail
Scombresocidæ	1	1	Garfish
Cyprinidæ	2	3	Carp, Tench
Gonorhynchidæ	1	1	Sand Eel
Clupeidæ	2	3	Anchovy, Sprat
Synbranchidæ	1	2	Chilobranchus
Muræindæ	4	5	Common Eel, Conger

Pegasidæ	1	1	Sea-dragon
Syngnathidæ	5	9	Pipefish, Sea-horse
Sclerodermi	2	12	Leather Jacket, Trunkfish
Gymnodontes	4	5	Toad Fish, Porcupine Fish
Total Teleostei (49)	121	186	

SUB-CLASS CHRONDROPTERYGII (Sharks and Rays).

SHARKS.

Chimæridæ	1	1	Elephant-fish
Carcharidæ	4	4	Blue Shark, Tope, Gummy
Lamnidæ	3	3	Porbeagle, Nurse, Thrasher
Notidanidæ	1	1	Tasmanian Blue Shark
Scyllidæ	3	4	Wobbigong
Cestracionidæ	1	1	Port Jackson Shark
Spinacidæ	1	2	Spiny Dog
Rhinidæ	1	1	Angel Shark
Pristiophoridæ	1	2	Sawfish

RAYS.

Rhinobatidæ	1	1	The Fiddler
Torpedinidæ	1	1	Electric Torpedo
Rajidæ	1	1	Thorn-back Skate
Trygonidæ	1	1	Stingaree
Myliobatidæ	1	1	Whip-tail Ray
Total Sharks and Rays	21	24	

SUB-CLASS CYCLOSTOMATA.

Petromyzontidæ	2	2	Lamprey, Pouched Lamprey

SUB-CLASS LEPTOCARDII.

Cirrostomi	1	1	Lancelet

SUMMARY.

Sub-class	Families.	Genera.	Species.
Teleostei	49	122	186
Chrondropterygii	14	21	24
Cyclostomata	1	2	2
Leptocardii	1	1	1
Grand Total	65	146	214

COMPLETE LIST OF TASMANIAN SPECIES.

SUB-CLASS TELEOSTEI.

Fam. PERCIDÆ. (13.)

Perca fluviatilis, *Rondel.* (I.) English River Perch.

Callanthias Allporti, *Gunth.* (T.) Allport's Perch. D. 11 : 10. A. 3 : 10. L. lat. 46.

Enoplosus armatus. Old Wife. D. 7 : 1·14-15. A. 3·15.

Anthias rasor, *Rich.* (A.) Red Perch : Barber. D. 10 : 21. A. 3 : 9. L. lat. 54. L. tr. 4 : 18.

Microperca Tasmaniæ, *Johnston.* (A.) Native Perch. D. 8 : 1·7-8. A. 3·8 : V. 1·5. L. lat. 28-30 : L. tr. 12.

Lates colonorum, *Gunth.* (A.) Brackish Water Perch. D. 8 : 1-10. A. 3·8. L. lat. 55. L. tr. 8 : 21.

Oligorus gigas, *Owen.* (A.) Hapuka. (T.Z.) D. 11 : 12. A. 3·8.

Eurumetopos Johnstonii, *Morton.* (T.)

Apogon Guntheri, *Cast.* A. Brackish Water Perch. D. 7 : 1-9 : L. lat. 26. L. tr. 11-12.

Apogon Lemprieri, *Johnston.* (T.) D. 6 : 1-10. A. 2·9. L. lat. 27. L. tr. 3-10.

Arripis truttaceus, *Cuv.* and *Val.* (A.Z.) Native Salmon. D. 9 : 16-17. A. 3 : 10. L. lat. 48-52. L. tr. 6 : 12.

Histiopterus recurvirostris, *Rich.* (A). Boar Fish. D. 9 : 15. A. 3·10-11. P. 18. L. lat. 130.

Erythrichthys nitidus, *Rich.* (A.Z.) D. 9 : 3 : 1·9-10. A. 5·10. L. lat. 96. L. tr. 8 : 20.

Fam. SQUAMIPINNES. (1.)

Scorpis Georgianus, *Cuv.* and *Val.* (A.) D. 9 : 26. A. 3 : 27.

Fam. MULLIDÆ. (1.)

Upeneus porosus, *Cuv.* and *Val.* (A.Z.) Red Mullet. D. 8 : 1-8. A. 7. L. lat. 30.

SPARIDÆ. (5.)

Girella tricuspidata, *Cuv.* and *Val.* (A.) Black Bream. D. 15·11-13. A. 3·11-12. L. lat. 50. L. tr. 10-11 : 20-23.

Girella simplex, *Rich.* (A.) The Sweep. D. 14-15 : 12-13. A. 3·11-12. L. lat. 55. L. tr. 11-12 : 20-23.

Haplodactylus arctidens, *Rich.* (T.) Marbled Kelp Fish. D. 15-16 : 18-20 : A. 3·7 : P. $\frac{10-2}{6}$

Chrysophrys Australis, *Gunth.* (A.) Silver Bream. D. 11 : 10-11. A. 3·8. L. lat. 44-45 : L. tr. 5 : 13.

Pagrus unicolor, *Cuv.* and *Val.* (A.Z.) Schnapper. D. 12·10. A. 3·8. L. lat. 52. L. tr. 8 : 17.

Fam. HOPLOGNATHIDÆ. (1.)

Hoplognathus Conwayii, *Rich.* Hoplognathus. D. 12 : 12. A. 3·12.

Fam. Cirrhitidæ. (14.)

Chironemus marmoratus, *Gunth.* (A.) Large Kelp Fish. D. 14 : 1-18. A. 3·6. L. lat. 55.

Chilodactylus spectabilis, *Hutton.* (T.Z.) D. 17 : 26. A. 3·6. L. lat. 55.

Chilodactylus Allporti, *Gunth.* T. Carp. D. 17 : 25-28. A. 3·9. P. 8·6. L. lat. 55-56.

Chilodactylus carponemus, *Park.* (T.) Great Perch D. 17 : 31-32. A. 3·17-18. L. lat. 64.

Chilodactylus macropterus, *Rich.* (A.) Black Silver Perch. D. 17-18 : 25-28. A. 3·12-14. P. 9·6. L. lat. 55 : 4-5. L. tr. 6 : 13-15.

Chilodactylus nigripes ? *Rich.* Black Silver Perch. D. 18 : 26. A. 3·10. L. lat. 61. 5 simple pectoral rays.

Chilodactylus nigricans, *Rich.* (A.) Black Butter Fish.

Chilodactylus vizonarius, *Kent.* (T.) Magpie Perch. D. 17 : 26-33. A. 3·9-10. L. lat. 63. 6 simple pectoral rays.

Nemadactylus concinnus ? *Rich.* (T.) Magpie Perch. D. 17 : 28. A. 3·15. L. lat. 50.

Latris hecateia, *Rich.* (T.Z.) Trumpeter. D. 17 : 1·36-38. A. 3·28-30. P. 9·8-9. L. lat. 100.

Latris Forsteri, *Cast.* (A.) Bastard Trumpeter. D. 16 : 1·37-42. A. 3·33-36. P. 9-10·8-9. L. lat. 115-120.

Latris ciliaris, *Forst.* (A.Z.) Moki. D. 17 : 39. A. 3·32. L. lat. 84. P. 6.

Latris Mortoni ? *Kent.* (T.) Morton's Trumpeter. (Teeth on Vomer. L. lat. 110.)

Mendosoma Allporti, *Johnston.* Real Bastard. D. 23 : 1·25-26. A. 3·18-19. P. 15-16. L. lat. 72-74.

Fam. Scorpænidæ. (7.)

Sebastes percoides, *Soland.* (A.Z.) Gurnet. D. 11 : 1·12. A. 3·5. L. lat. 60-65.

Scorpæna cruenta, *Soland.* (A.Z.) Little Gurnet. D. 11 : 1·10. A. 3·5. L. lat. 45 ?

Scorpæna panda, *Rich.* (A.Z.) D. 12 : 1·8. A. 3·5. L. lat. 67.

Holoxenus Guntheri, *Johnston.* (T.) Velvet Fish. D. 8 : 5·10. A. 3·9. C. 12-13. V. 1·5.

Holoxenus cutaneus, *Gunth.* (T.) D. 7 : 3·10. A. 9. C. 12. V. 1·5.

Pentaroge marmorata, *Cuv.* and *Val.* (A.) Soldier. B. 7. D. 12-13 : 10. A. 3·6.

Glyptauchen panduratus, *Rich.* (A.) D. 17 : 7. A. 3·6. V. 1·5.

Fam. Berycidæ. (2.)

Beryx affinis, *Gunth.* A. Nannegai. D. 7 : 12. A 4 : 12-13. V. 1 : 7. L. lat. 41-43. L. tr. 6 : 12.

Trachichthys Macleayi, *Johnston.* D. 5 : 13. A. 3·10. V. 8. L. lat. 50. 13 scutes.

Fam. Kurtidæ. (1.)

Pempheris macrolepis, *Macleay.* (A.) D. 4-5 : 12. A. 3·33-36.

Fam. Sphyrænidæ. (2.)

Sphyræna Nova-Hollandiæ, *Gunth.* (A.) D. 5 : 1·9. A. 1·10. L. lat. 135.

Lanioperca mordax, *Gunth.* (A.) Tasmanian Jack. D. 5 : 1·19. A. 2·25-29. P. 16. L. lat. 61.

Fam. Atherinidæ. (6.)

Athernia presbyteroides, *Rich.* Silver Belly, Sand-smelt. D. 9 : 10-11. A. 1·12. P. 11.

Atherina hepsetoides, *Rich.* Silver Belly. D. 9 : 1·11. A. 1·14. P. 15.

Atherina hepsetus, *L.* Silver Belly.

Atherina microstoma, *Gunth.* Silver Belly. D. 6 : 1·10. A. 1·12. P. 12. L. lat. 40. L. tr. 8.

Atherina Tamarensis, *Johnston.* (T.) Silver Belly. 8 : 1 : 11. A. 1·10-11. P. 13. L. lat. 42. L. tr. 9.

Atherenichthys Jacksoniana, *Quoy* and *Gaim.* D. 8 : 1·11. A. 1·18.

Fam. Mugilidæ. (2.)

Mugil cephalotus, *Cuv.* and *Val.* (A.) Sand Mullet. D. 4 : 1·8. A. 3·7-8. L. lat. 38-40. L. tr. 14-15.

Agonostoma Forsteri, *Bl.* Sea Mullet, Estuary Mullet. D. 4 : 1·10. A. 3·12. L. lat. 55.

Fam. Centriscidæ. (1.)

Centriscus scolopax, *L.* (A.) Snipe, Bugler, or Trumpet Fish. B. 4. D. 5 : 12. A. 20. P. 16.

Fam. Gobiesocidæ. (2.)

Crepidogaster Tasmaniensis, *Gunth.* (A.) B. 5. D. 10. A. 9.

Gobiesox cardinalis, *Ramsay.* (T.)

Fam. Lophotidæ. (1.)

Lophotes Guntheri, *Johnston.* (T.) Lophotes.

Fam. Trachypteridæ. (2.)

Regalecus gladius. *Cuv.* and *Val.* Ribbon Fish. B. 6. D. 342. A. 0. C. 0. P. 14. V. 1.

Trachypterus altivelis, *Kner.* Paper Fish. B. 6. D. 7 : 190. A. 0. C. 6 : 4-6. P. 11. V. 7.

Fam. Pomacentridæ. (1.)

Glyphidodon Victoriæ. Rock Perch. D. 13 : 17. A. 2 : 15. L. lat. 30. L. tr. 4 : 10.

Fam. LABRIDÆ. (13.)

Cossyphus cerulæus, *Ogilby.* (A.) Blue Head.

Cossyphus unimaculatus, *Gunth.* (A.) D. 12 : 11. A. 3·12. L. lat. 36. L. tr. 6·12.

Labrichthys bothryocosmus, *Rich.* (A.) Parrot Fish. D. 9 : 11 : A. 3·10. L. lat. 27. L. tr. 3 : 9.

Labrichthys Mortoni, *Johnston.* Golden Parrot Fish. D. 9 : 11. A. 3·10. L. lat. 23.

Labrichthys fucicola, *Rich.* Purple Parrot Fish. B. 6. D. 9 : 11. A. 3·10. L. lat. 27. P. 13.

Labrichthys psittacula, *Rich.* Parrot Fish. D. 9 : 11. A. 3·10. L. lat. 27. L. tr. 3·9.

Labrichthys laticlavius, *Rich.* Blue-streak Parrot Fish. D. 9 : 11. A. 3·10. L. lat. 26. L. tr. 3·9.

Labrichthys tetrica, *Rich.* Parrot Fish. D. 9 : 11. A. 3·10. L. lat. 27. L. tr. 3·9

Labrichthys Cuvieri, *Cast.* Parrot Fish. D. 9 : 11. A. 3·10. L. lat. 27.

Odax balteatus, *Cuv.* and *Val.* Ground Mullet. D. 15-17 : 12-13. A. 3·12-13. L. lat. 39.

Odax Richardsoni, *Gunth.* Stranger. D. 17 : 13-14. A. 3·10-12. L. lat. 60. L. tr. 7 : 20.

Odax Beddomei, *Johnston.* Beddome's Odax. D. 20 : 12. A. 3·9. L. lat. 40. L. tr. 3·8-9.

Olistherops Brownii, *Johnston.* Brown's Olistherops. D. 10 : 18. A. 3·9. L. lat. 58-60. L. tr. 7·14.

Fam. GADOPSIDÆ. (1.)

Gadopsis marmoratus, *Rich.* Freshwater Blackfish. B. 6. D. 10-13 : 25-26. A. 3 : 18-19. V. 1.

Fam. GADIDÆ. (2.)

Lotella Swanii. *Johnston.* Kelp Cod. B. 7. D. 4 : 60. A. 55. V. 8. P. 22-23. L. lat. 200.

Pseudophycis barbatus, *Gunth.* Rock Cod. D. 9-11 : 48-57. A. 44-57. V. 5. L. lat. 100-140.

Fam. OPHIDIIDÆ. (2.)

Genypterus Australis, *Cast.* Ling. B. 7. D. 159. A. 123-126. P. 19. L. lat. 261-307.

Fierasfer Homei, *Rich.* Home's Ling. B. 7. Fins very low. Continuous.

Fam. MACRURIDÆ. (2.)

Macrurus Australis, *Rich.* (A.) D. 13·88. A. 87. V. 7. L. lat. 130. L. tr. 4 : 15.

Coryphænoides Tasmaniæ, *Johnston.* (T.) Tasmanian Whip-tail. B. 7. D. 15 : 103. A. 90. V. 8.

Fam. PLEURONECTIDÆ. (4.)

Amnotretis rostratus, *Gunth.* (T.) Sole. B 7. D. 79-81. V. dext. 6-7.; sin. 4. L. lat. 89-90.

Rhombsolea monopus, *Gunth.* (A.) Flounder. B. 5. D. 59-60. V. 6. A. 42-43.

Rhombsolea tapirina, *Gunth.* (A.) Flounder. B. 6-7. D. 64-66. A. 46-50.

Solea liturata ? *Rich.* (T.) Richardson's Sole.

Fam. HAPLOCHITONIDÆ. (2.)

Prototroctes maræna, *Gunth.* (A.) Freshwater Herring or Cucumber Fish. B. 6. D. 10. A. 19. O. 13. L. lat. 78. L. tr. 19.

Haplochiton Sealii, *Johnston.* (A.) Derwent Smelt. B. 6. D. 8-9. A. 19-20. P. 9-12.

Fam. SCOPELIDÆ. (1.)

Alepidosaurus ferox, *Lowe.* (T.) B. 6-7. D. 41-44. A. 14-17. P. 14-15. V. 9-10.

Fam. SALMONIDÆ. (5.)

Retropinna Richardsoni, *Gill.* (A.Z.) Whitebait. B. 6. D. 11-12 : A. 17-20. P. 11. V. 6. L. lat. 61.

Salmo salar, *L.* (I.) Salmon. B. 11-12. D. 14. A. 11. P. 14. V. 9. L. lat. 120. L. tr. 22-26 : 19-22.

Salmo trutta, *Flem.* (I.) Salmon Trout. B. 11. D. 13. A. 11. P. 15. V. 9. L. 6-120. L. tr. 24-26 : 36-34.

Salmo fontinalis, *Milch.* (I.) Golden Trout.

Salmo fario, *var. Ausonii.* (I.) Brown Trout. D. 13-14. A. 10-11. P. 13. V. 9. L. lat. 120. L. tr. 26-30 : L. tr. 26 : 30.

Fam. GALAXIDÆ. (5.)

Galaxias truttaceus, *Cuv.* and *Val.* (T.) Spotted Trout. B. 9. D. 11. A. 14-15. V. 7. P. 14.

Galaxias auratus, *Johnston.* (D.) Golden Lake Trout. B. 9 D. 11-12. A. 14. V. 1·7. P. 16.

Galaxias attenuatus, *Jenyns.* (A.Z.) Jolly Tail. D. 12. A. 16. V. 7.

Galaxias Weedoni, *Johnston.* (T.) Mersey Jolly Tail. D. 11. A. 14. P 15.

Galaxias Atkinsoni, *Johnston.* (T.) Pieman Jolly Tail. B. 9. D. 11. P. 13. A. 14. V. 8.

Fam. SCOMBRESOCIDÆ. (1.)

Hemirhamphus intermedius, *Cant.* (A.Z.) Gar Fish. D. 15-17 A. 18-20. P. 11.

Fam. CYPRINIDÆ. (3.)

Carassius vulgaris, *Nilsson.* (I.) European Carp.

Carrassius auratus, *L.* (I.) Gold Fish.

Tinca vulgaris, *Cuv.* (I.) English Tench.

Fam. GONORHYNCHIDÆ. (1.)

Gonorhynchus Greyi, *Rich.* (A.Z.) Sand Eel. B. 4. D. 11-13. A. 9. V. 9.

Fam. CLUPEIDÆ. (3.)

Engraulis enchrasicholus *(var. antipodum)*, *L.* The Anchovy. B. 12-13. D. 16-17. A. 18-20. L. lat. 48-50.

Clupea sprattus, *L.* The Sprat. B. 6-7. D. 15-18. A. 17-20. V. 7. L. lat. 47-48.

Clupea sagax, *Jenyns.* Pilchard. B. 7. D. 18. A. 18-19. L. lat. 50-54.

Fam. SYMBRANCHIDÆ. (2.)

Chilobranchus dorsalis, *Rich.* (A.) Small Shore Eel.

Chilobranchus rufus, *Macleay.* (A.) Red-banded Shore Eel.

Fam. MURÆNIDÆ. (5.)

Anguilla Australis, *Rich.* (A.) Common Eel.

Conger vulgaris, *Cuv.* (A.) Conger Eel.

Conger Wilsoni, *Cast.* (A.Z.) Conger Eel.

Muræenichthys breviceps, *Gunth.* (A.)

Congromuræna habenata, *Rich.* (A.Z.) Silver Eel.

Fam. PEGASIDÆ. (1.)

Pegasus lancifer, *Kaup.* (A.) Pegasus. D. 5. A. 5. P. 15. V. 2.

Fam. SYNGNATHIDÆ. (9.)

Syngnathus, semifasciatus, *Gunth.* (A.) Pipe Fish. D. 38. O. R. 21+49.

Syngnathus curtirostris, *Cast.* (A.) Pipe Fish. D. 20-22. O. R. 18+42.

Stigmatophora argus, *Rich.* (A.) Pipe Fish. D. 49-52. O. R. 20+75.

Stigmatophora nigra, *Kaup.* (A.) Pipe Fish. D. 39-40. O. R. 17+42.

Stigmatophora gracilis, *Macleay.* (T.) Pipe Fish. D. 58. O. R. 30+56.

Solenognathus spinosissimus, *Gunth.* (A.) Pipe Fish. D. 35. O. R. 27+56.

Phyllopteryx foliatus, *Shaw.* (A.) Leaf-winged Sea Horse. D. 30. O. R. 18+35.

Hippocampus abdominalis, *Kaup.* (T.) Sea Horse. D. 28-31.

Hippocampus breviceps, *Peters.* (A.) Yellow-ringed Sea Horse. D. 19-21.

Fam. SCLERODERMI. (12.)

Monocanthus Gunnii, *Gunth.* Dark Brown Leather Jacket D. 34. A. 33.

Monocanthus convexirostris, *Gunth.* Grey Leather Jacket. D. 34-37. A. 32-35.

Monocanthus Peronii, *Holland.* Pale Brown Leather Jacket. D. 33-35. A. 33.

Monocanthus Guntheri, *Macleay.* Tooth-brush Leather Jacket.

Monocanthus spilomelanurus, *Quoy* and *Gaim.* Golden Streak-eyed Leather Jacket. D. 30-32. A. 28-32.

Monocanthus maculosus. *Rich.* Small Brown Leather Jacket. D. 29-33. A. 29-30. P. 12.

Monocanthus Baudini, *Cast.* Lozenge-scaled Leather Jacket. D. 35. A. 31. P. 13.

Monocanthus melas, *Gunth.* Black Leather Jacket. D. 34. A. 34.

Monocanthus rudis, *Rich.* White-banded Leather Jacket. D. 34-35. A. A. 34.

Monocanthus hippocrepis, *Quoy* and *Gaim.* Blue-banded Leather Jacket. D. 35-37. A. 33-36.

Ostracion auritus, *Shaw.* Trunk Fish. Head spine deflected.

Ostracion ornatus, *Gray.* Trunk Fish. Head spine erect, pointing out.

Fam. GYMNODONTES. (5.)

Tetrodon Hamiltoni. *Rich.* Toad Fish.

Tetrodon Richei, *Frem.* Globe Fish.

Chilomycterus jaculiferus, *Cuv.* A. Porcupine Fish.

Atopomycterus nychthemerus, *Cuv.* Slender spined Porcupine Fish.

Orthagoriscus mola. *L.* Sun Fish. D. 17-18. A. 14-17. C. 12-16. P. 12-13.

SUB-CLASS. CHONDROPTERYGII.

Fam. CHIMÆRIDÆ. (1.)

Callorhynchus antarcticus, *Lacep.* Elephant Fish.

Fam. CARCHARIDÆ. (4.)

(Eye with a nictitating membrane. 1 anal and 2 dorsal fins.)

Carcharius glaucus, *L.* (E.) Blue shark.

Galeus canis, *Rondel.* (E.) The Tope. School Shark.

Zygæna malleus, *Shaw.* Hammer-head.

Mustelus antarcticus, *Gunth.* Smooth Hound. Gummy.

Fam. LAMNIDÆ. (3.)

(No nictitating membrane. 1 anal and 2 dorsal fins.)

Lamna cornubica, *Flem.* Porbeagle.

Odontaspis Americanus, *Mitch.* Grey Nurse.

Alopecias vulpes, *L.* Thrasher.

Fam. NOTIDANIDÆ. (1.)

(1 dorsal only. 1 anal.)

Notidanus indicus, *Cuv.* Tasmanian Blue Shark

Fam. SCYLLIDÆ. (4.)

(No nictitating membrane. 2 dorsal and 1 anal fin).

Scyllium maculatum. *Bl.*
Scyllium laticeps, *Dum.*
Parascyllium variolatum, *Dum.*
Crossorhinus barbatus, *L.* Wobbigong.

Fam. CESTRACIONIDÆ. (1.)

(No nictitating membrane. 2 dorsal and 1 anal fin.)

Heterodontus Phillipii, *Lacep.* Port Jackson, or Bull-head Shark.

Fam. SPINACIDÆ. (2.)

(No nictitating membrane. No anal fin.)

Acanthias vulgaris, *Risso.* A. Spotted Spiny Dog.
Acanthias Blainvillii, *Risso.* A. Spiny Dog.

Fam. RHINIDÆ. (1.)

(No anal fin. Pectoral fins large.)

Rhina squatina, *L.* Angel Shark.

Fam. PRISTIOPHORIDÆ. (2.)

(Snout much produced, saw-like.)

Pristiophorus cirratus, *Latham.* (A.) Sawfish. Sets teeth upper jaw, 42.
Pristiophorus nudipinnis, *Gunth.* (A.) Sawfish. Sets teeth upper jaw, 35-39.

RAYS.

Fam. RHINOBATIDÆ. (1.)

Trygonorhina fasciata, *Mull and Henle.* The Fiddler.

Fam. TORPEDINIDÆ. (1.)

Narcine Tasmaniensis, *Rich.* Electric Torpedo. Disc elliptical.

Fam. RAJIDÆ. (1.)

Raja Lemprieri, *Rich.* Thorn-back Skate.

Fam. TRYGONIDÆ. (1.)

Urolophus cruciatus, *Lacep.* Stingaree.

Fam. MYLIOBATIDÆ. (1.)

Myliobatis aquila. *L.* Eagle or Whip-tail Ray.

SUB-CLASS. CYCLOSTOMATA.

Fam. PETROMYZONTIDÆ. (2.)

Mordacia mordax, *Rich.* (A.) Common Lamprey.
Geotria Allporti, *Gunth.* (T.) Pouched Lamprey.

SUB-CLASS LEPTOCARDII.

Fam. CIRROSTOMI. (1.)

Branchiostoma lanceolatum, *Pall.* The Lancelet.

FISHING INDUSTRY.

With a scattered and insulated population of about 150,000 inhabitants, it cannot be expected that the fishing industry of Tasmania can be extensive. Nevertheless it is estimated that there are about 86 boats and 175 men engaged therein. The individuals employed hawking the fish within the two chief towns may be estimated at about 80 in number. Altogether it is estimated that, exclusive of the whaling trade, there are 1,050 persons directly depending upon the local fisheries. Hobart, the capital city, is the chief centre of the industry, its position being favourable in this respect from its proximity to the principal fishing-grounds, and its splendid harbour being accessible in all kinds of weather.

Fully 63 per cent. of the men and boats belong to Hobart, and the men carry on their vocation either in the numerous sheltered indentations or bays in the upper or lower waters of the estuary of the Derwent, or in the exposed open sea between Seymour on the north-east and Port Davey on the south-west. The fishing carried on elsewhere, with the exception of the purely river fishing of the Tamar, is very limited, generally engaged in at odd times by persons who do not devote themselves exclusively to the fishing industry. The Tamar boats are not suited for fishing in the open sea of Bass Straits.

With the exception of three or four decked smacks, the most of the boats employed in the waters of the Derwent, or in the open sea Trumpeter and Barracouta fishing-grounds, are mere open centre-board whaleboats, fitted with fish-wells perforated in direct communication with the sea, and designed to keep the fish alive until sold in the open market in the Fisherman's Dock, Hobart.* The Trumpeter and other fish will feed in such confinement, and the former has been known to live healthily in this way for a period of three months.

The average value of one of these excellent sea-boats† is about £100, and the equipment, in the shape of nets and deep sea lines, say £20; in all, say £120 for each boat. There are usually two or three men to each boat. Even with a small crew of this kind, as much as 40 dozen Kingfish, weighing 12 to 14lbs. each, have been caught in a single night when the fish have been plentiful. Barracouta can be captured in large quantities during the season—January to June. About 24 dozen Barracouta weigh a ton. The fishermen state that, could they be assured of a market, 3s. a dozen for Barracouta or Kingfish would amply repay them,—*i.e.*, about ¼d. a pound.

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* Salt water.

† Generally about 37 feet 6 inches long; beam, 7 feet 8 inches; depth, about 3 feet.

The following are additional particulars regarding the average quantity of fish exported each year, which hitherto have been despatched almost wholly to Victoria:—

	Doz.	Weight.	Average Price.
		lbs.	
Trumpeter *(Latris hecateia)*...	66	3 to 60	1s. per lb.
Perch *(Chilodactylus macropterus)*..........................	123	2 to 7	6s. to 7s. per doz.
Trevally *(Neptonemus brama)*...	52	1 to 14	8s. to 12s. per doz.
Barracouta *(Thyrsites atun)*.....	1132	9 to 10	3s. per doz.
Kingfish *(Thrysites Solandri)*...	1056	12 to 14	3s. per doz.
Conger Eel *(Conger vulgaris)*...	44	7 to 50	½d. per lb.
Crayfish *(Palinurus Edwardsii)*	923	avg. 4	5s. per score.
Total per year...............	3396		

It is very difficult to estimate the value of fish sales, as no systematic register has been kept for the whole colony. It is probable, since the decline of the Oyster fishery, that the yearly sales do not exceed £10,000 per annum.

The value of boats and equipment at present engaged in the fishing industry of Tasmania may be roughly estimated at about £7,700. This does not embrace the ships employed in the Whale fisheries. The latter industry has declined considerably during the last decade, as shown by the following summary:—

	Average per year, First Quinquennium.	Average per year, Second Quinquennium.
Ships	16	11
Tonnage	4,164	3,055
Men	390	312
Value of Oil......	£31,281	£19,223

The reason of this falling off is stated to be chiefly owing to the decline in price arising from the introduction of minerals oils. Excessive fishing and consequent scarcity of oil is also referred to as a cause of decline.

FISHING GROUNDS.

Generally, the Fishing Grounds may be divided into three classes:—1. The Home Grounds 2. The Middle Grounds. 3. The Outer, or Open-sea Grounds.

1. *The Home Grounds*, near shore, or in the upper shallows of the estuaries of the Derwent and Tamar.—The fishing grounds at Port Sorell, Bridport, and George's Bay may be included with this division. The fish captured in these situations consist chiefly of Flounders, Mullet, Garfish, Flathead. Crayfish, Prawns, and Oysters are also taken in the Home Grounds.

2. *The Middle Grounds.*—Within this division may be included those fishing reefs and banks lying in the more exposed situations of estuaries—such as Wedge Bay and Adventure Bay, in the Derwent—in depth of water from five to six fathoms. In such localities the grab-all net and ordinary hand-lines are used in the capture of Native Salmon, Silver Bastard, Black and Silver Perch, Carp, Rock Cod, Ling, Conger Eel, etc. The indentations around the Eastern and Western Coasts afford ample scope for following out the industry within the limits of this division, especially so in the many sheltered bays in the neighbourhood of Port Davey and Macquarie Harbour.

3. *The Outer, or Open-sea Grounds.*—These principally are situate in the southern and eastern waters of Tasmania, and generally from 1 to 16 miles off the coast, upon coral banks or reefs 10 to 80 fathoms deep. The latter depth is the limit at which Tasmanian fishermen have been successful with deep sea-lines on the Trumpeter banks. Towards the surface of these open waters the Maori jig is principally used in the capture of the Barracouta, and in the season the line, armed with swivelled chain and stout barbless hook, is employed in the capture of the rapacious but valuable Kingfish.

The fishermen, as a class, are as a rule steady and industrious, and although they do not seem to have any special provision in the shape of Friendly Societies or other providential aids, distress is rare and poverty unheard of. Beyond the provisions for acclimatisation and protection of the European Salmonidæ, the establishment of Oyster beds for breeding purposes, and certain reserves for the protection of natural beds, the Government have also found it necessary to provide measures for the limitation of the sale of unwholesome or undersized fish, and for prescribing the size of mesh for *graball* and *seine nets.* No graball can be used in Tasmanian waters whose mesh is of any size, measured diagonally, between 2½ inches and 4 inches.

The prescribed limits of undersized fish that may be taken or sold are:—

Bastard	12	inches	and	over
Real Trumpeter	13	"	"	"
Garfish	8	"	"	"
Bream	10	"	"	"
Flounders...	9	"	"	"
Crayfish	10	"	"	"

In the case of the introduced Salmonoids, and as regards the Oyster and Flounder, special provisions have been made for their preservation and development in respect of close seasons, modes of capture, and the absolute or partial closing of particular areas as nursery grounds as a means of protection. This was absolutely necessary to ensure the successful acclimatisation of the Salmonidæ first introduced from Europe in the year 1864.

The fishes successfully introduced are *Salmo salar*, *Salmo trutta*, *Salmo fario* var. *Ausonii*, *Salmo fontinalis*, *Tinca vulgaris*, *Cyprinus auratus*, *Cyprinus carassius*, *Perca fluviatilis*.

FISH SOLD IN HOBART FISH MARKET DURING THE YEAR 1888.

	Quantity	Price.			Value.		
Fish.		Max.	Min.	Average	£	s.	d.
Barracouta ....doz.	2,410	10s.	7s.6d.	8s.	964	0	0
Bream .... "	9	14s.	8s.	10s.	4	10	0
Carp .... "	103	5s.	3s.	4s.	20	12	0
Eels (Conger) .... "	70	12s.	10s.	11s.	38	10	0
Flathead .... "	2,241	1s.	1s.	1s.	112	1	0
Flounders .... "	1,126	6s.6d.	4s.	5s.	281	8	0
Garfish .... "	10,229	1s.	5d.	6d.	255	14	6
Gurnet (Rock) .... "	111	4s.	2s.9d.	3s.	16	13	0
Kingfish .... "	¾	60s.	60s.	60s.	2	5	0
Ling .... "	21	24s.	3s.	7s.	7	7	0
Mullet .... "	3,202	1s.9d.	4d.	1s.	160	0	0
Mackerel (Horse) ...... "	68	2s.	4d.	1s.	3	8	0
Perch .... "	3,629	5s.	3s.6d.	4s.	735	16	0
Ditto (Red) .... "	3	4s.	4s.	4s.	0	12	0
Rock Cod .... "	2,158	2s.	1s.	2s.	215	16	0
Salmon (Native) .... "	2,358	1s.	4d.	8d.	78	12	0
Trumpeter (Real) .... "	447	100s.	20s.	31s.7d.	737	10	0
Ditto (Red Bastard) "	3,431	5s.6d.	4s.	5s.	857	15	0
Ditto (Silver ditto).. "	46	48s.	12s.	17s.6d.	30	12	6
Trevally .... "	75	6s.	2s.	4s.	15	0	0
Whiting .... "	16	3s.	1s.	1s.6d.	1	4	0
Crustaceans.	31,753				4,539	6	0
Crayfish .... score	3,434	5s.	4s.	5s.	858	10	0
Molluscs.							
Cockles .... bushels	8	5s.	5s.	5s.	2	0	0
					£5,399	16	0

SALMON AND TROUT BREEDING ESTABLISHMENT.

	1882.	**1883.**	**1884.**	**1885.**	**1886.**	**1887.**	**1888.**
Ova introduced from Europe ...	...	...	80,000*	160,000*	...	...	400,000*
Ova exported to other Colonies..	24,000	17,000	2,000	7,500	13,000	12,000	6,000
Salmon Fry liberated in various Rivers, etc.......	3,950	6,600	8,650	31,229[d]	116,200	33,880	9,000
Licences issued—Receipts from Sales of Ova and Licenses...	297	266	216	253	263	269	258
Working Expenses...........	277[a]	319	355[b]	465[c]	341	296	437

* *Salmo salar.*

[a] Exclusive of £100 for importation of ova.

[b] Exclusive of £460 for importation of Ova from England.

[c] Includes £170, special repairs to troughing.

[d] Includes 28,128 fry of *S. salar*, *ex* ova per *Yeoman*, from Ireland, hatched at the Plenty.

GENERAL FISHERIES DEPARTMENT.

	1882.	**1883.**	**1884.**	**1885.**	**1886.**	**1887.**	**1888.**
Receipts................	...	...	...	...	...	...	...
Working Expenses..	...	...	...	935	...	1,369	677

WHALE FISHERIES.

Year.	Vessels employed.		Tonnage.	Value of Fisheries.	Remarks.	
	Ships.	Boats.				
				£		
1828	3	23	...	11,268	In 1822, 724 tuns oil and 3 tons whale fins were exported. In 1823 226 casks of oil and 52 pkgs. whalebone were exported.	
1829	7	26	...	12,313		
1830	10	42	...	22,065		
1831	9	55	...	33,549		
1832	12	75	...	37,176		
1833	15	105	...	30,620		
1834	23	84	...	56,450		
1835	35	155	...	64,858		
1836	14	48	1,187	57,660		
1837	18	75	2,739	135,210		
1838	19	79	1,999	98,660		
1839	26	...	3,146	65,600	FOREIGN.	
1840	27	...	3,224	66,850		
1841	22	...	3,170	71,600	Ships.	Tonnage.
1842	18	...	2,842	87,400		
1843	21	...	3,307	74,100		
1844	24	...	4,264	49,840	12	3,838
1845	28	...	4,460	73,300	16	5,518
1846	28	...	4,057	65,150	13	4,825
1847	27	...	4,729	70,000	21	6,890
1848	29	...	6,081	104,000	26	8,497
1849	34	...	7,791	46,117	11	3,803
				Oil exported.		
1850	40	...	9,724	49,547	9	2,779
1851	26	...	6,538	49,022	14	4,687
1852	18	...	3,999	36,776	18	6,300
1853	7	...	1,903	30,106	2	704
1854	6	...	1,622	27,863	2	737
1855	17	...	3,566	44,110		
1856	33	...	6,975	53,670		
1857	...	...	...	46,211		
1858	...	...	...	49,878		

Year.	Vessels.	Tonnage.	Value of Oil Exported.	No. of Men.
			£	
1859	...	...	63,500	...
1860	...	...	57,350	...
1861	...	...	60,230	...
1862	...	...	60,730	...
1863	...	...	30,175	...
1864	...	...	19,925	...
			Produce brought into Port.	
1866	9	2,257	38,000	229
1867	10	2,428	22,800	245
1868	16	3,996	52,546	395
1869	17	4,364	48,910	415
1870	15	3,446	35,880	376
1871	19	4,917	46,350	470
1872	19	4,917	27,420	488
1873	18	4,765	44,000	444
1874	16	4,088	30,780	389
1875	13	3,525	12,465	315
1876	13	3,525	41,740	315
1877	12	3,295	31,605	324
1878	11	3,156	16,920	321
1879	11	3,156	13,425	326
1880	10	2,780	12,045	296
1881	10	2,780	22,120	296
1882	8	2,357	19,096	196
1883	7	2,014	14,685	168
1884	6	1,745	11,715	151
1885	7	2,014	12,600	167
1886	5	1,480	6,150	124
1887	4	1,151	10,450	99
1888	3	783	6,165	70

DO THE CHANGES OF THE MOON AFFECT THE RAINFALL?

BY E. C. NOWELL, HON. MEMBER ROYAL STATISTICAL SOCIETY.

The idea that the changes of the moon do affect the rainfall has widely prevailed from the earliest ages. Thus the Roman poet Virgil :—

> " And that by sure prognostics we may know
> Both heat and rain and cold-compelling winds,
> The Sire himself has fixed the monthly course
> Of lunar indications; by what sign
> To read the sinking south ; what, oft observed,
> Should teach the farmer to retain his herds
> Within the sheltered precincts of the stall."
> Georg I., 351 seqq., Dear's trans.

> " Nor less are showerless suns and open sky
> Serene by certain signs fore-known ; for then
> Nor dimly seem the blunted stars to shine,
> Nor rises Luna to her brother's beams
> Indebted : then nor through the vault of heaven
> Sail fleecy clouds ; nor to the genial beam
> Do Thetis' halcyons spread their azure wings.
>
> * * * *
>
> When the moon,
> Collecting first her renovated fires,
> A gloomy mist within her horns includes,—
> Then on the husbandman and on the deep
> Impends a heavy rain ; but, if she rise
> Her face suffused with virgin blushes, wind
> Awaits ; the wind on golden Phœbe's cheek
> Ever excites a blush ; but should she take
> At her fourth rising (mark the surest sign)
> Her course through heaven's ætherial way with clear
> Unclouded aspect, nor with horns obtuse,
> Then that whole day and those from thence derived,
> E'en to the finished month, shall roll exempt
> From wind or rain; and, on the shore secure,
> The storm-scaped mariner shall pay his vows
> To Glaucus, Panope, and Ino's son."
> Ib., 393 seqq.

Ages before, the Babylonian Government astronomers in their reports, which they furnished daily, have such entries as these respecting the supposed influence of the heavenly bodies on the weather :—

" The star of the upper sphere aforesaid causes fog and rain."

" The star Lulu portends extended mists."

" The star of the Wolf portends tempest."

" The stars at sunrise are for windy rain and flood."

Sailors especially are great believers in the influence of the moon on the weather.

I believe it will be found that, where ideas have become deeply rooted and widely spread, it is very seldom, if ever, that they have not some foundation in fact, though the fact may have been distorted, and the truth more or less obscured.

We have been assured, however, by some whose names carry great weight, and whose statements on such matters we should not venture to question, except on the clearest evidence, that the popular notion is a mere delusion, and that the moon's changes have no influence on the weather.

Dr. R. J. Mann, vice-president of the Meteorological Society, in an article on "High Clouds and Moonshine," in "Science for All," part 52, says:—"Amongst the long prevalent notions that have been held concerning the changes of the weather, there are, perhaps, none that have been more generally entertained and cherished than those which connect them with what are termed the changes, or, in other words, recurring phases of illumination of the moon. These notions, in all probability, were in the first instance derived from the accidental coincidence of certain marked conditions of weather with particular aspects of the moon, and from the natural tendency which exists in the minds of superficially instructed people to ascribe to the heavenly bodies a power over human events. A very few words of comment will, nevertheless, suffice to expose the fallacy of this illusion. The proposition, however, to which these remarks are addressed is, it must be remarked, not simply and in a general sense that the moon affects the weather experienced upon the earth, but that the mere aspects of the moon's varying illumination exert an especial influence upon the weather of each particular locality and spot.

"The utter irrationality and absurdity of this idea becomes apparent at a glance the instant it is connected with the obvious fact that the earth is a rotating and not a fixed globe. Assuming, for the mere purpose of illustration, that it were true the new moon, the half moon, and the full moon produced some especial state, whether of storm or of calm, whether of rain or of dryness upon some given spot on the earth, as this passes round in front of the sun-illumined orb, it is manifest the same influence must continue to be exerted entirely round the earth during the subsequent twenty-five hours in which the terrestrial sphere whirls completely round before the moon;" and so on. Further on, he says:—"If the phases of the moon affected the weather, it is obvious that the same weather would prevail wherever analogous relations to the moon obtained.

"The moon, as a matter of fact, does produce a physical influence upon the earth, but it is an influence of an altogether different kind to the one which is implied by this popular piece of weather delusion; it is the influence which is so grandly expressed in the diurnal roll of the tides of the sea, and which is due to the inter-action of the lunar and terrestrial mass." In regard to the tides the same writer tells us: "It is the moon which is operative in bringing about the result, and not the 'phases' or appearance of the moon."

But, we may ask, is not the distinction here drawn between the moon herself and her "phases" rather one of words than of things? If the moon's changes of position, which we call her "phases," cause corresponding changes in the weather, there certainly would be good reason for associating such changes with the phases under which they occur, whether the popular mode of stating the fact were strictly correct or not.

Dr. Mann goes on to say: "Now, there can be no question that the moon does produce a somewhat similar effect upon the atmosphere to that which it exerts upon the sea. As it goes round the earth, and as the earth whirls upon its axis in front of the attendant orb, a tidal swell is called up in that part of the atmosphere which is most immediately opposite and nearest to the lunar mass;* and this tidal wave in the air undoubtedly is accompanied by some change of physical state which would involve alteration of pressure, and which would be to that extent indicated by the barometer, and would tend to produce movement in the air or wind, and such weather change as is attendant upon wind. But all this, it will be observed, has nothing whatever to do with the phases or changes of the moon. The effect, whatever it may be, is precisely the same whether the moon is new, or half illuminated, or full. It is determined and measured only by the revolution, distance, and mass of the moon, and by the dimensions and rotation of the earth." But the inference is drawn from certain observed facts "that the heat reflected from the full moon does exert a palpable effect upon the atmosphere, although it does not penetrate to the solid surface of the earth;" and Sir John Herschel is said to have noticed "how very commonly the nights of the full moon at the Cape of Good Hope were absolutely cloudless and clear;" and this observation, we are informed, is confirmed by the experience of nearly nine years of the author of the article from which I have quoted in the neighbourhood of Natal.

Dr. Lardner, in his "Weather Prognostics" (Museum of Science and Art, vol. I. p. 80), after reviewing the investigations of different persons on the subject of the moon's influence on the weather, observes: "Those who are impressed with the feeling that an opinion so universally entertained, even in countries remote from each other, as that which presumes an influence of the moon over the weather, must have some foundation, will do well to remember that against that opinion we have not here opposed mere theory. Nay, we have abandoned for the occasion the support that science might afford, and the light it might shed on the negative of this question, and have dealt with it as a mere question of fact. It matters little, so far as this question is concerned, in what manner the moon and sun may produce an effect on the weather, nor even whether they be active causes in producing such effects at all. The point, and the only point of importance is, whether regarded as a mere *matter of fact*, any such correspondence between the changes of the moon and those of the weather exist, as is popularly supposed? And a short examination of the recorded facts proves that IT DOES NOT." And Dr. Ball, Royal Astronomer of Ireland, in his "Story of the Heavens," published in 1886, p. 59, says: "There is one widely credited myth about the moon which must be regarded as devoid of real foundation. The idea that the moon and the weather are connected has no doubt been entertained by high authority, but careful comparison has shown that there is no definite connection between the two." I venture to think that the results which I shall bring before the members of this Society will show that these opinions are premature, and will have to be modified, and that, after all, the popular persuasion is not without some foundation in fact.

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* One cannot help noticing the remarkable coincidence between the words of the ancient poet already quoted, *fratris radiis obnoxia Luna*, and those of the exponent of modern science.

Seeing that the statements of scientific men and the popular notions on the subject of the moon's influence on the weather seemed to be at variance, I resolved to investigate the matter for myself; and accordingly in 1880 I began to keep a meteorological journal in a rough way, and have continued it up to the present time. There is only one hiatus of about a fortnight, caused by my absence from home. Having now ten years' observations to work upon, I thought I might safely proceed to ascertain what conclusions might be drawn from them, and with that view prepared table B appended to this paper.

It should be mentioned that every fall of rain, however slight, unless unintentionally omitted, is recorded; and that rain is noticed in the tables only on the first day on which it occurs in connection with any particular change. When, therefore two or more rain-days come together, only the first is tabulated, the others being omitted: but when a break of a whole day occurs, any subsequent fall of rain is treated as distinct, and tabulated accordingly.

I have thought it better not to go beyond the seventh day, since it is only occasionally that the interval between one change of the moon and another extends beyond that day.

By way of testing the accuracy of my own observations, I constructed another table (A) on the same principles, from the data furnished by the late Mr. F. Abbott, and published in the papers of this Society, taking in the previous ten years, from 1870 to 1879 inclusively. If the two tables be thrown into one, they will embrace a period of twenty years, from 1870 to 1889. In Mr. Abbott's tables, as printed, I found two gaps, one of a month, and another of a fortnight, but was fortunately able to supply the omissions from the meteorological journal kept by Mr. W. E. Shoobridge, which he was kind enough to leave in my hands.

My observations, as thus tabulated, give the following results for the ten years from 1880 to 1889.

Taking first the totals opposite to each day, without reference to the nature of the moon's changes, we find that the number of times on which rain commenced in the decennium as a whole was as follows :—

On the day of the change	114
„ second day „	103
„ third „ „	98
„ fourth „ „	92
„ fifth „ „	88
„ sixth „ „	73
„ seventh „ „	82

It will be seen that the number on the day of change is considerably in excess of the number on any of the other days, being at the rate of 18 per cent. nearly of the whole number (650) on the seven days, while the next highest is only about 16 per cent.

The corresponding numbers for the period 1870-79 were :—

On the day of the change	135
„ second day „	80
„ third „ „	97
„ fourth „ „	81
„ fifth „ „	93
„ sixth „ „	83
„ seventh „ „	84

Here again we find the largest number on the day of the change. But in regard to the other days, the two periods vary. In the first decennium (1870-79) the next largest was on the third day; in the second decennium (1880-89), on the second.

The proportion which the numbers on the day of change bore to the total (653) on all the seven days in the first period was nearly 21 per cent.

In the second decennium (1880-89) it was found that the next largest figure was that opposite to the second day; while, in the first decennium, the next largest was in connection with the third day. Taking the two periods together the relative frequency of rain in the twenty years would be as follows:—

First day of change	249	
Second day „	183	
Third „ „	195	
		627
Fourth „ „	173	
Fifth „ „	181	
Sixth „ „	156	
Seventh „ „	166	
		676
		1,303

Thus, it appears that 48 per cent. of the rainfalls, as here noted, occurred on the first three days of the moon's changes, being only 2 per cent. less than in the remaining four days. It will be observed that the numbers are appreciably smaller on the sixth and seventh days.

Taking now the totals under each of the moon's quarters, in the two periods, we get the following results:—

1880-89.

Total number of initial rainfalls in the whole period in	Last quarter,	159
	New moon,	165
	First quarter,	167
	Full moon,	162

1870-79.

Total number of initial rainfalls in the whole period in	Last Quarter,	177
	New Moon,	146
	First Quarter,	177
	Full Moon,	150

So far as these periods, taken separately, go, we cannot discover any law of relation between the changes, or quarters, of the moon, and the rain-fall; but when we combine the totals of the two tables and take the whole period of twenty years, the result is similar to that which we get from the latter of the two decennial periods (1870-79), the numbers for the twenty years being:

Last Quarter ...	336
New Moon ...	311
First Quarter ...	344
Full Moon ...	312

The difference between the two pairs, the first and last quarters on the one hand, and the new and full moon on the other, are so marked, as at once to suggest the idea that it is not altogether due to chance. If this be so, then there is a greater probability of rain occurring at the first and last quarters than at the new and full moon.

In my enquiries I have not given any attention to the question how far, if at all, the rain-fall is affected by the moon's apogee or perigee. But it is only reasonable to suppose that, if the greater or less proximity of the moon to the earth affects the tides, it must also cause some corresponding modification in those conditions of the atmosphere which regulate the suspension and condensation of moisture in the upper regions.

Lardner, in the work above cited, tells us that Toaldo, from a comparison of 45 years' observations at Padua, found that in every six passages of the moon through perigee there were five changes of weather, and in every five through apogee there were four changes of weather (p. 72); and that Professor Pilgrim, from a 25 years' series of observations at Vienna, arrived at the result that the influence of perigee is greater than that of any of the phases, while the influence of apogee is equal to that of the quarters and full moon, and greater than that of the new moon (p. 73). But Lardner considers that the mode in which these conclusions were reached was such as to throw some doubt upon the results. He seems to attach more weight to the investigations of M. Schübler, who, from observations taken at Munich, Stuttgard, and Augsburg, for 28 years, found that during the seven days nearest to perigee it rained 1,169 times, and during the seven days nearest to apogee, only 1,096 times. "Thus," remarks Lardner, *cæteris paribus*, the nearer is the moon to the earth the greater would be the chances for rain" (p. 75).

Further on he says: " From all that has been stated it can scarcely be denied that there exists some correspondence between the prevalence of rain and the phases of the moon. What that exact correspondence is, remains for more extended and accurate observations to inform us; but meanwhile it may be safely affirmed that it is not such as to constitute a prognostic in any sense approaching to that in which it has been popularly adopted." (*Ib.*)

With this I entirely agree; and, so far as the foregoing enquiries enable us to pronounce an opinion on the subject, the only thing which we can with any safety assert with regard to this subject, is, that there is a greater probability of having rain on the first than on any succeeding day of any of the moon's changes.

The enquiry, the results of which I have thus attempted to put before the members of this Society, will, I hope, be found to be of some value, however slight, as a contribution towards the investigation of an obscure but highly interesting subject.

Perhaps these remarks may induce others, more competent, to pursue the enquiry in a more scientific manner, and more exhaustively, than I have been able to do.

It will, of course, be understood that the inferences deduced from the appended tables are intended to apply only to the place where the observations were made, namely—Hobart and its vicinity. We may expect to get different results from similar observations at other places, and it remains to be seen whether the same laws hold good elsewhere under different conditions, or whether they are so far modified by local circumstances that each place, or group of places, has a law of its own.

In a work which I was reading a short time since, I came upon this passage:—"It is a scientific fact that virtue and vice are resultant upon the changes of weather. The police of Buenos Ayres find that quarrelling and bloodshed are more frequent when the wind blows from the north, that a sort of moral derangement prevails while it continues. The scientific explanation offered is, that this arises from some malaria engendered in the marshes over which the wind passes." (W. J. Acomb, Larger Hope Lectures, 156.)

This opens up a wide field of study which has not, as far as I know, been systematically cultivated. The present age stands out prominently as one of *disinterment*. Buried cities, such as Nineveh, Babylon, Herculaneum, Pompeii, Troy, have been unearthed; lost languages and literature have been restored. If the same method of enquiry be applied to immaterial things there can be no doubt that similar results will follow. If we closely examine many of the things which in past times were devoutly believed, but which most people in these days look upon as exploded errors, we shall find that, just as gold is embedded in quartz and has to be separated from it, in these old notions there are truths which only require to be set free from the misconceptions which were associated with them to be recognised as scientific facts. Take, for instance, lunacy. The idea was that the aberration of mind so-called, was occasioned by some malign influence of the moon. Increased knowledge has shown that the causes of insanity are very various, and that the moon has little, if anything, to do with them; but if I am not mistaken, many mad people *are* peculiarly affected at certain states of the moon, and the observation of this fact may have led to the assumption that the moon was the cause of the disease. We have seen that she does produce such an effect upon the atmosphere as to bring on rain under certain conditions. But as the organism of both men and animals is affected by changes of weather, and as such changes are, more or less, brought about by lunar action, it follows of necessity that the moon does exercise a certain amount of control over the bodies and minds of living things, though, doubtless, not in the way and to the extent formerly imagined. Many persons of sensitive temperament are powerfully affected by moonlight; and we can easily understand how much greater the impression must be when the mind is off its balance.

Take, again, astrology. Of course, none of us believes in astrology, as commonly understood—that is, we do not believe that men's future destinies can be read in the stars in the same way as the astrologers pretended; but I think there are grounds for admitting that the stars may, like the moon, only in a less degree, have an influence on human affairs. Some years ago (in 1876) it was predicted that a rare conjunction of the greater planets would cause unusual perturbations on our earth; and certainly in the last ten years there have been greater disturbances in the physical world than have ever occurred before in my time. And in the moral world there have been corresponding disorders. It is quite conceivable that these abnormal phenomena may have had their origin in some changes of the other planets in relation to the earth, altering the force of their attraction, and so, perhaps, the magnetic condition of our globe. Whatever affects our physical state produces a corresponding change in the mind and its affections, and thus many of the remarkable tendencies of our time may be the result of atmospheric or telluric influences due to some obscure changes occurring elsewhere in the universe of which we form a part. If it be true, as modern science teaches, that the whole of creation is so bound together, and so finely adjusted, that whatever takes place anywhere produces some effect on every other portion, we need not stumble at the thought that the vast masses of matter which whirl round the centre of our system may, by their changes of position, alter the condition of things on our planet, and so have an influence upon our physical, moral, social and spiritual life.

If this be so, then it will be within the province of science to extend its researches in this direction, in order to discover, if possible, what are the exact nature and limits of the influence exerted upon the earth and its inhabitants by the moon and the remoter planets—the lesser forces—as well as by the great central source of power—the sun itself.

TABLES.

Number of days on which rain began to fall in the two decennial periods, 1870-79 and 1880-89, in connection with the changes of the moon:—

A. 1870-79.

Days of and following the Moon's Changes.	Last Quarter.	New Moon.	First Quarter.	Full Moon.	Total.
1	37	37	35	26	135
2	20	19	21	20	80
3	22	24	23	28	97
4	19	18	24	20	81
5	27	25	23	18	93
6	21	22	17	23	83
7	13	20	24	27	84
—	159	165	167	162	653

B. 1880-89.

Days of and following the Moon's Changes.	Last Quarter.	New Moon.	First Quarter.	Full Moon.	Total.
1	29	24	34	27	114
2	28	27	25	23	103
3	25	21	31	21	98
4	26	27	17	22	92
5	24	18	26	20	88
6	18	17	16	22	73
7	27	12	28	15	82
—	177	146	177	150	650

PROVISIONAL AID TO THE STUDY OF THE TASMANIAN MOLLUSCA.

By R. M. Johnston, F.L.S.

The student of Conchology in Tasmania labours under many disadvantages, owing to the circumstance that the *descriptions* of the various species inhabiting our waters are scattered widely in various publications of Europe and America, while nearly half of the number of the principal *type species* are deposited in foreign museums, and are therefore inaccessible for purposes of reference to local students.

Before we can rest satisfied with the existing classification of many species there is much careful work to be done; for it is well known that the specific descriptions of the earlier distinguished collectors who accompanied expeditions to our seas, are often too meagre to satisfactorily distinguish or separate them from many allied distinct species subsequently discovered. Such accidental collections, too, very naturally contain many forms belonging to widely variable species, and the individuals, of necessity taken by them as types, do not always present the most suitable characters which would serve to distinguish the central type of a widely variable species, and hence the local observer, unable to refer to original types described, is often puzzled or uncertain in his determinations.

It would be well, therefore, to follow the example of New Zealand, in making up a duplicate collection of our shells as complete as possible, and thereafter submit one of them to a well-known European authority like Ed. Von Martins, who would critically examine and compare them with original types in European collections, and submit a critical report for the guidance of local workers. Such a course has already been adopted by New Zealand under the guidance of Professor Hutton, one of the ablest authorities, and certainly one of the most energetic naturalists in Australasia; an example which Tasmania would do well to follow. If Messrs. Legrand, Petterd and Beddome, who have so ably worked in this branch of science in Tasmania, and who possess the best local collections, were to engage in a work of this kind under the auspices of the Royal Society of Tasmania, I am satisfied that the very best results would be attained, and we would then prepare the way for the publication of a work on Tasmanian Mollusca that we could place thorough dependence upon.

It will be observed that although the whole of the 716 known species contained in the list prepared by me were described by over 75 distinct authors at different times and in various publications, yet the greater half (384) were described by five persons, and among these the Rev. J. E. Tenison-Woods alone described 212 species, or nearly a third of the whole. Following next in order to the work of this gifted naturalist last named (whose death, recently, is a loss which all Australasians most deeply deplore), come the names of Lamarck, Reeve, Sowerby, Petterd, Cox, Deshayes, Brazier, Quoy, A. Adams, Gray, Beddome and Angas, all of whom score double figures as regards the number of species described by them respectively.

My own contributions to local Conchology hitherto have been mainly confined to the Fossil Mollusca, although I have been enabled to give the results of long extended observations, and have added 9 new species to the list, in various papers contributed at different times to this Society. Taking the names of Tenison-Woods, Petterd, Cox, Brazier, and Beddome, as local workers, we have some reason to be proud of their accomplishments, for although later in the field, and only numbering 5 out of the 75 authors of species, they have between them described nearly half the number of all the known Tasmanian species.

The labours of the Rev. J. E. Tenison-Woods, F.L.S., etc., deserve special reference, for his writings in all branches of Australasian Natural History are so numerous and valuable that they form in themselves a considerable library. Apart from his many works published in the proceedings of kindred societies in Australia and New Zealand, his interesting volume published many years ago on the Geology of South Australia, and his fine work on the Fishes and Fisheries of New South Wales, he has contributed no less than 31 important communications to the Royal Society of Tasmania, four of which form the chief source of our information concerning the marine and fresh water shells of this Island.

Nor must we forget the labours of another local worker, who although not appearing among the authors of species, has perhaps done more for the science of Conchology in this island than any other single person. I refer to Mr. W. Legrand. This indefatigable naturalist may truly be regarded as the Pioneer of Conchology in Tasmania. He, assisted by Dr. Cox and Mr. Brazier, published the first really important work on Tasmanian Conchology in the year 1870 (Monograph of Tasmanian Land Shells), which afterwards formed the principal part of Mr. Petterd's later monograph on the same subject, published in the year 1878. Nor were Mr. Legrand's labours confined to the land shells. For many years he was the only person who possessed an extensive knowledge of our local mollusca; and such was his enthusiasm and industry in the investigation of the Conchology of Australia generally, that Mr. Woods regarded his collection in the year 1875 to be the "finest in the southern hemisphere;" and writing in acknowledgment of the great services which he rendered to himself in the preparation for his census of Tasmanian shells, published in 1877, by generously placing at his disposal the whole of his fine collection, and by affording him the greater benefit of his vast store of local information, he refers to Mr. Legrand's monograph in the following terms:—"Within the last few years Mr. W. Legrand has published a monograph of all the (then) known land shells, accompanied with extensive notes on the habits, and very excellent figures of the newer species. What gave the work a greater value, was that it was for the most part privately printed by the author. The whole of the work being done by his own hand."

Next in order of time to Mr. Legrand comes Mr. Petterd. Mr.W. F. Petterd, C.M.Z.S., is a native of Hobart, Tasmania, whose name will ever stand a credit to the land of his birth. Almost self-taught in natural history, he has by natural talent accomplished more and better work than many of the European Naturalists, who have had the advantages of immediate reference to the stored and classified collections of the world's great observers. Mr. Petterd is undoubtedly the "Tam Edwards" of Tasmania. His love for natural history as a youth fortunately attracted the notice of our veteran Conchologist, Mr. Legrand, to whom Mr. Petterd, with many others—myself among the number—owe a lasting debt of gratitude for the kindly help and encouragement always readily bestowed.

Mr. Petterd's keen perception, bright intelligence, and taxidermical skill, combined with a rare facility for depicting the objects which interested his attention by artistic drawings, soon gave him a wide and thorough command of the principal forms of local natural history in Tasmania. Nor were his observations and collections of natural objects confined to his native country. He travelled as an observer widely over Australia, from Cape Howe to the Gulf of Carpentaria, and was one of the early pioneer explorers of New Guinea and the Islands of the Pacific. His splendid collections made in all these regions have largely increased our store of knowledge and have enriched the principal Museums of Europe, Australia and America. As a Conchologist he is best known by his fine "Monograph of the Land Shells of Tasmania," read before this society and published in the year 1879. This work has deservedly obtained for him the widest reputation. His contributions on Conchology to the Royal Society of Tasmania since that time have greatly extended our knowledge, and he is now, I believe, engaged upon an elaborate treatise on the shells of Tasmania, which will in the future be the standard work of reference to Tasmanian students.

The labours of Lieut. C. E. Beddome have also added largely to our knowledge, and his contributions respecting new forms (17 species), brought to light by his extensive dredging investigations, come very close to those of Mr. Petterd. Mr. Beddome has also contributed several interesting papers to this Society on Conchology, and he is now the possessor of one of the finest collections in Australasia. He prepared a splendid classified collection of our shells for the Fisheries Exhibition held in London in the year 1887, for which he was awarded First Prize and a Gold Medal.

Nor must we forget in this place the valuable work of the Rev. H. D. Atkinson, of Circular Head. This gentleman has for many years been a most enthusiastic collector. Some of the most interesting forms contained in the Rev. J. E. Tenison-Woods' "Census," were brought to light by Mr. Atkinson, who was the first person in Tasmania who extended his researches into the deeper waters by means of the dredge. At the time Mr. Woods was preparing his "Census," Mr. Atkinson was the only person in Tasmania who sought for novelties in this way.

The labours of Mr. B. Dyer, of Hobart, Mr. R. Gunn, and Mr. A. Simson, of Launceston, as collectors, are also worthy of special notice in this place.

Since the appearance of the Rev. J. E. Tenison-Woods' Catalogue of Tasmanian Shells, valuable critical emendations have been made by Prof. Tate and Mr. John Brazier, and these have been availed of by me in the preparation of the Classified List attached to this paper. These gentlemen have also largely contributed in the extension of our knowledge of the Mollusca. Mr. Brazier's contributions to our knowledge of the land and fresh water shells are especially extensive.

In the following pages I have given a fairly comprehensive account of the bibliography of the subject, and for the convenience of local students who are not in possession of works of reference, I have added a part devoted to the description of the various families, mainly based upon the late G. W. Tryon's splendid work on "Structural and Systematic Conchology," (April, 1884.) To afford additional facilities to such students, I have also prepared an artificial key to the classes, families, and genera, which I hope will prove to be of service. In the preparation of this key, I have been greatly aided by a similar key prepared by Prof. Hutton for his excellent work on the Conchology of New Zealand, (Manual of the New Zealand Mollusca,) published in the year 1880.

In conclusion, I may add that this contribution can only be considered merely as a provisional aid to students of Tasmanian Conchology; but it is hoped it may serve a useful purpose until such time as a more complete work makes its appearance. No doubt it is possible I have failed to notice recent minor contributions which may have appeared in foreign publications, and in the compilation from so many sources, I may have allowed some errors to creep in, but I think these are few and unimportant, and will not materially interfere with its general usefulness.

ARTIFICIAL KEY TO THE FAMILIES.

I. MARINE UNIVALVES.

GASTEROPODA.

(1.) Shell regularly spiral.

(*a.*) *Shell fusiform, tapering to each end, moderately large.*

Large anterior canal, short, recurved, varices not more than 5	Tritonidæ, viii.
Canal straight, short, varices three or more	Muricidæ, vii.
Canal usually straightish and long, no varix	Fusidæ, ix.
Shell notched in front, ovately fusiform	Buccinidæ, x.
Shell with columella plaited, polished aperture, nearly as long as the shell, narrow	Volutidæ, xii.
Columella plaited, aperture small, narrow, not exceeding half the length of shell	Mitridæ, xiii.
Columella plaited, aperture oblong, whorls cancellated, last one inflated	Cancellaridæ, xvii.
Shell small, inner and outer lip crenulated interiorly	Columbellidæ, xvi.
Shell small, somewhat ventricose and rugose, inner lip with a posterior shining callosity, or blunt dentiform plait, anterior canal short, reflected truncate	Nassidæ, xi.

(*b.*) *Shell convolute, the aperture nearly as long as the shell.*

*Spire moderate.

Spire and columella lip covered with enamel, shining	Olividæ, xv.
Small, collumela plaited, outer lip thickened in middle	Marginellidæ, xiv.
Small, columella plaited, aperture, rounded in front	Tornatellidæ, liii.

Small, columella plaited or toothed, spire short	Auriculidæ, lxiv.

**Spire very short.

Aperture with a recurved canal	Cassididæ, xxii.
Shell inversely conical	Conidæ, xx.

*** Spire none.

Oval, aperture narrow	Cypræidæ, xxi.
Shell cylindrical, small	Cylichnidæ, liv.
Small, white, pellucid, last whorl expanded	Philinidæ, lii.
Moderate or large, inflated	Bullidæ, lv.
Like *Bullidæ*, shell thin, *flexible*	Lophocercidæ, lvi.

(c.) Shell turreted, elongate or subulate.

Outer lip indented near the suture, canal long and straight	Pleurotomidæ, xix.
Shell elongated, polished, richly coloured, shelly operculum	Phasianellidæ, xliii.
Whorls ribbed, sutures deep	Scalaridæ, xxvi.
Aperture channeled in front, subulate	Cerithiidæ, xxxiv.
Aperture with an oblique notch in front	Terebridæ, xviii.
Shell awl-shaped, spirally striate, aperture rounded	Turritellidæ, xxviii.
Very small, milk white, polished	Eulimidæ, xxx.
Very small, slender, many whorled, whorls plaited	Turbonillidæ, xxxi.
Very small, aperture oavte, columella truncate	Planaxidæ, xxxiii.
Very minute, elongate, whorls flattish, covered with brownish epidermis	Rissoeliidæ, xxxv.
Very small, aperture entire, often umbilicated, columella smooth	Part Rissoidæ, xxxvi.

(d.) Shell globular or turbinated.

Polished, aperature semi-circular	Naticidæ, xxiii.
Aperture semi-circular, columella flat	Neritidæ, xl.
Shell thin, blue	Ianthinidæ, xxvii.
Aperture rounded, not pearly inside	Littorinidæ, xxxii.
Aperture rounded, pearly inside, operculum horny	Trochidæ, xlv.
Like Trochidæ, but with shelly operculum	Turbinidæ, xliv.

(e.) Shell conical, with a flat base.

Shell not pearly inside, umbilicated	Solariidæ, xxv.
Shell not pearly inside, not umbilicated	Littorinidæ, xxxii.
Shell pearly inside, lip without slit	Trochidæ, xlv.
Shell pearly inside, lip perforated, or with a slit	Pleurotomariidæ, xlvii.
Base with a half cup shaped shelf or plate, apex sub-central	Calyptræidæ, xxiv.

Shell depressed, lenticular	Rotellidæ, xlii.

(f.) Shell oval shaped.

Interior with a shelly process	Calytræidæ, xxiv.

(g.) Shell depressed or ear shaped.

Shell depressedly turbinate, umbilicated	Liotiidæ, xli.
Shell ear shaped, thin, fragile, pellucid	Naticidæ, xxiii.
Shell ear shaped, nacreous not perforated	Stomatellidæ
Shell ear shaped, nacreous perforated with holes	Haliotidæ, xlviii.

(2.) Shell irregularly spiral.

Aperture rounded, entire, or with a longitudinal slit	Vermetidæ, xxix.

(3.) Shell flat or simply conical.

Conical, curved anterior, margin notched or the apex perforated	Fissurellidæ, xlix.
Conical or depressed, neither notched nor perforated	Patellidæ, l.
Like Patella, but having a projection formed over a siphonal groove on right side	Siphonariidæ, lxvii.
Shell small, translucent trigonal	Aplysiidæ, lvii.

(4.) Shell multivalve.

Shell composed of eight separate imbricating plates	Chitonidæ, li.

CLASS SCAPHOPODA.

(5.) Shell tube-like, tapering posteriorly	*Dentaliidæ*, lxviii.

(II.) MARINE BIVALVES.

CLASS PELECYPODA.

(A.) Bivalves cemented to or contained within a shelly tube.

Shell either small, equilateral, cemented to the lower end of a shelly tube, umboes alone visible, as in *Aspergillum*, or wholly contained within a tube as in *Gasterochœna*	Gastrochænidæ, lxix.

(B.) Bivalves not cemented or contained within a shelly tube.

(1.) ***Dorsal margin protected by one or more accessory valves.***

Shell gaping at both ends, thin, brittle white, very hard. Borers	Pholadidæ, lxxi.

(2.) ***Bivalves lacking accessory valves.***

(a.) Two adductor impressions, nearly equal.

* Pallial line ***sinuated.***

†Ligament external.

Very long, sub-cylindrical, straight ends gaping	Solenidæ, lxxii.
Equivalve thick, gaping	Saxicavidæ, lxxiii.
Shell rounded, beaks turned forward; hinge teeth 2—2	Semelidæ, lxxviii.
Compressed, thin ligament, anterior	Tellinidæ, lxxix.
Shell rugosely striated and ribbed, sinus profound	Petricolidæ, lxxxii.
Three diverging teeth in each valve	Veneridæ, lxxx.
†† Ligament internal.	
Small, thick, produced behind	Corbulidæ, lxxiv.
Thin, cartilage with a free ossicle	Anatinidæ, lxxv.
Ligament in a triangular pit; two cardinal teeth	Mactridæ, lxxvi.
Ligament in a triangular pit; one cardinal tooth	Paphiidæ, lxxvii.
Hinge with many teeth in a line, inside pearly	Nuculidæ, xcii.
** Pallial line *simple*.	
† Ligament external.	
Trigonal, radiately ribbed, inside pearly	Trigoniidæ, xci.
Radiately ribbed, cordate not pearly	Cardidæ, lxxxiii.
Thin, orbicular, white, divaricating striæ	Lucinidæ, lxxxv.
Inequivalve thick, attached by left umbo	Chamidæ, lxxxiv.
Sub-orbicular, smooth, ligament double submarginal. No lateral teeth	Ungulinidæ, lxxxvi.
Minute, thin, sub-oval, usually transparent	Erycinidæ, lxxxvii.
†† Ligament internal.	
Large, solid, oblong, ventricose, attenuate behind, smooth or concentrically furrowed	Crassatellidæ, lxxxviii.
Roundly ovate, strongly radiately ribbed	Astartidæ, lxxxix.
Hinge, many teeth in a line, not pearly	Arcidæ, xciii.
Hinge, many teeth in a line, pearly inside	Nuculidæ, xcii.

(*b.*) Two adductor impressions, very unequal, umbones anterior.

Shell equivalve, oval or elongated, inside pearly	Mytilidæ, xciv.
Shell large, equivalve wedge shaped, thin, brittle	Pinnidæ, xcvi.
Shell small, eared, thin, transparent, or having pearly interior, often gaping	Aviculidæ, xcv.

(*c.*) One adductor impression.

Shell irregular, radiately ribbed, spiny, usually 2 hinge teeth in each valve	Spondylidæ, xcvii.

Shell inequivalve, upper one flat, no teeth	Ostreidæ, ci.
Shell thin, perlaceous, with a deep notch or hole in the inferior valve, attached	Anomiidæ, c.
Shell eared, sub-orbicular, radiately ribbed	Pectinidæ, xcviii.
Shell eared, white, gaping at the sides, equivalve often minute	Limidæ, xcix.
(C.) Shell globular, three lobed, concentrically striated, open in front and behind, lodged at the extremity of a shelly lined tube or burrow	Teredidæ, lxx.

CLASS BRACHIOPODA.

(D.) Shell round or oval, perforated near or at the apex. minutely punctate	Terebratulidæ, cii.

(III.) LAND AND FRESH WATER MOLLUSCS.

(A.) Land Slugs, or Snails; shell none, or rudimentary.

Shell rudimentary, a calcareous plate concealed under the mantle, jaw of animal without ribs	Limacidæe, lxi.
Shell rudimentary, often composed of a few calcareous grains, jaw of animal strongly ribbed	Arionidæ, lxii.

(2.) *Land Snails, with shell more or less spiral and fully developed.*

Shell small, oval, with short spire, fragile, whorls few, rapidly enlarging, resembling some fresh water *Lymnæa*	Succineidæ, lxiii.
Shell usually thin, corneous, transparent, plaits spiral, of few rapidly enlarging whorls, animal too large to entirely enter	Vitrinidæ, lviii.
Shell of variable form, large or very minute, smooth, rugose, striated ribbed or cancellate, sometimes pilose, orbicular planoid convex, planorboid trochiform (Helix Launcestonensis) sub-turriculated or short—Helix—shell large, oblong, spiral (Bulimus)	Helicidæ, lix.
Shell minute, multispiral, cylindrical, with obtuse summit, pupiform, aperture small, usually contracted by internal teeth or lamellæ. Whorls reversed in local example	Pupidæ, lx.

(B.) Fresh water or sub-aquatic, nearly all more or less covered with a dark brownish epidermis.

(a.) Spiral univalves.	
* Sub-aquatic.	
Shell minute, cylindrical apex, truncated whorls, striated transversely—margins of sea shore	Truncatellidæ, xxxix.
Shell, smooth, elongated, perforated, whorls very convex, aperture round, peristome slightly expanded or reflected, apex frequently decollate. (Pomatiopsis)	Part Rissoidæ, xxxvi.
** Aquatic.	
(1.) † *Shell very minute, depressed, conical or umbilicated*	Valvatidæ, xxxviii.
(2.) †† *Shell very minute,* 4 to 6 whorls, *sub-umbilicated,* elongate, ovate or pupiform (Bithynella), turbinately ovate, inner lip more or less reflected. (Beddomeia)	Part Rissoidæ, xxxvi.
Shell minute, turbinately elongate, sub-perforate. (Hydrobia.)	
(3.) ††† Shell small, globosely rounded, ovate imperforate, inner lip thickened. (Brazieria.)	
(4.) Shells found in or near brackish water. Small, minute, globosely conical, sharp lip	Assiminiidæ, xxxvii.
Shell, moderate, sub-globose, banded	Amphibolidæ, lxvi.
Elongate, minute, pyramidal pointed spire, flattish whorls. (Tatea.)	Rissoellidæ, xxxv.
(5.) Shell moderate size or minute with sharp spire more or less acuminate; columella lip with oblique plait above, oval, oblong, corneous translucent, dextral. (*Limnæa.*) Sinistral. (*Physa.*)	Part Limnæidæ, lxv.
Shell very minute, discoidal bi-concave. (*Planorbis.*)	
(b.) Non-spiral, pateliform or conical, base, partly closed by a flat shelf, leaving a semi-lunar aperture, apex inclined to the right. (*Gundlachia.*)	Part Limnæidæ, lxv.
Shell aperture simple, entire, conical, limpet-shaped, sometimes radiately ribbed. (*Ancylus.*)	

(c.) Bivalve shells minute, ovate, thin, olive or white. (Pisidium) Minute, sub-quadrate, thin, yellowish. (Sphærium or Cyclas.)	Cyrenidæ, lxxxi.
Shell, large, oblong-oval, blackish epidermis; umboes eroded, pearly inside	Unionidæ, xc.

LIST OF THE VARIOUS AUTHORS WHO HAVE DESCRIBED MORE THAN ONE LOCAL SPECIES, ARRANGED ACCORDING TO THE ORDER OF THEIR IMPORTANCE LOCALLY.

	Species Described. No.
1. Tenison-Woods	212
2. Lamarck	59
3. Reeve	39
4. Sowerby	37
5. Petterd	37
6. Cox	29
7. Deshayes	23
8. Brazier	19
9. Quoy	18
10. A. Adams	18
11. Gray	17
12. Beddome	17
13. Angas	15
14. Crosse	10
15. Linne	9
16. Johnston	9
17. Adams and Angas	9
18. Swainson	9
19. Pfeiffer	8
20. Quoy and Gaim	8
21. Tate	5
22. Chemnitz	5
23. Dunker	5
24. Martyn	4
25. Born	3
26. H. and A. Adams	3
27. Gmelin	3
28. Philippi	3
29. Hinds	3
30. Kiener	3
31. Stutchbury	3

32. Hanley ...	3
33. Frauenfield	2
34. Menke ...	2
35. Mueller ..	2
36. All others	63
Total ...	716

CLASSES, FAMILIES AND GENERA.

Descriptive Account of the Various Classes, Families and Genera of Molluscs Inhabiting Tasmania, Systematically Arranged According to Tryon, (" Structural and Systematic Conchology, 1884."

NOTE.—The Roman numbers refer to the number of the family, and the Arabic numbers in brackets to the number of the species ; both arranged in consecutive order in the systematic list.

Class CEPHALOPODA.

Cuttle Fish, Squids, Nautili, etc.

Head large, separate from the body; eyes large, lateral; ears developed; mouth with two *horny or shelly beak-like jaws* with fleshy lips, and surrounded by *eight or ten fleshy arms or numerous* tentacles, furnished with an entire or slit tube, used in locomotion, which is usually directed backwards in swimming.

SYNOPSIS OF FAMILIES.

A. Order Dibranchiata.

Animal breathing by a *single pair* of symmetrical branchiæ or gills; *eyes sessile; shell internal or none; mandibles horny*; arms with suckers.

Sub-Order Octopoda.

Arms, eight; no shell, (the so-called shell of the argonaut is the egg nest of the female.)

	Family
Sessile	Octopodidæ
Suckers slightly *pedicelled*; female having two of the upper arms expanded into broad webs, one of which secretes an egg nest (nautiliform shell.)	Argonautidæ

(i.) Family OCTOPODIDÆ.

Mantle supported by fleshy bands; no ceptralic aquiferous pores; arms subulate, elongated, more or less united by webs, their *suckers sessile.*

SYNOPSIS OF GENERA.

(1.) *Arms with two rows of suckers*	*Genus.*
(*a.*) *Body not finned.*	
Body *rounded*; arms long; suckers sessile; *third right arm of male* hectocotylised	Octopus (1.)
Differs from Octopus in having a small aquiferous system, consisting of a bag with a small pore at its lower edge upon the web between each arm	Cistopus (—)
Body *oval,* wider than head; arms short; cups with narrowed bases; third *left* arm hectocotylised	Scæurgus (—)
Arms united by a web nearly to the ends	Alloposus (—)
(*b.*) *Body Finned.*	
Body like Octopus, but finned; arms with two rows of suckers	Pinnoctopus (2)
(2.) *Arms with a single row of suckers*	
(*a.*) *Not Finned.*	
Body rounded, without fins; third right arm hectocotylised	Eledone (—)
More gelatinous than Eledone; suckers smaller, less developed	Bolitæna (—)
(6.) *Finned.*	
Body with two transverse medial fins; mantle united to the head nearly all round by a conical band; arms united by a web nearly to the tips	Cirroteuthis (—)
(3.) *Arms with three rows of suckers.*	
Body not finned.	Trixaxeopus (—)

(ii.) Family ARGONAUTIDÆ.

Mantle supported by two buttons fitting into grooves at the base of the siphuncle; the two upper or dorsal arms (in the females only) expanding into broad webs at their extremity, from which an egg-nest (shell) is secreted; cups slightly pedicelled; a pair of aquiferous pores at the upper hinder angle of the eye.

	Genus.
Characters those of the family; the third right arm of the male is hectocotylised; shell thin, translucent; nautiliform, white, usually two nodose keels at periphery	Argonauta (3)

SUB-ORDER DECAPODA.

Ten arms, of which *eight are sessile*, and *two* (longer) *tentacular*, shell internal.

(1.) *Internal shell horny.*

(*a.*) Eyes *covered by skin*; mostly littoral species.

	Family
Body long; tentacular arms, partially retractile	Loliginidæ
Body short; tentacular arms, completely retractile	Sepiolidæ

(*b.*) Eyes *naked*; Pelagic species.

Body long, cylindrical; arms or tentacles armed with *hooks*	Onychoteuthidæ
Body long, cylindrical; arms with *suckers* only	Ommatostrephidæ

(2.) *Internal shell calcareous.*

(*a.*) Shell blade like	Sepiidæ
(*b.*) Shell forming a series of chambers transversed by a siphon	Spirulidæ

(iii.) Family LOLIGINIDÆ.

Body rather long; buccal skin sometimes armed with suckers; tentacular arms only partially retractile; fins lateral, terminal; inner shell or *gladius as long as the back*. (Calamary.)

	Genus.
Body long, with posterior rhombic fins united behind; mantle supported by a cervical ridge, and by cup-like cartilages on the base of the funnel or siphon; siphon valved, attached by bands to the head; arms with two rows of suckers, provided with *horny dentated rings*; tentacular arms with *four rows* of suckers on their clubs; fourth	

	Genus.
left arm hectocotylised at its extremity; gladius feather-like, its shaft keeled on the ventral side	Loligo (—)
Body rather long or oval, with small lateral fins extending its entire length; siphon attached to the head by muscular bands; buccal skin with *seven* projections covered with suckers; a strong wrinkle behind the eyes; otherwise like *Loligo*	Sepioteuthis (6)

(iv.) Family ONYCHOTEUTHIDÆ.

Body long, cylindrical; mantle supported by cartilaginous projections; eyes with a lachrymal sinus; arms or tentacles *armed with hooks*; siphon with or without bands and valve; gladius or shell generally lancet form, with *end-conus*

	Genus.
Arms with two rows of suckers; rings not toothed; tentacles thick; *clubs armed with two rows of strong hooks*; bases of the same also strongly hooked; gladius or shell lancet form, with a conical commencement	Onychoteuthis (4)

Family OMMATOSTREPHIDÆ.

Arms *short*, with two rows of suckers; tentacles short, not retractile; the clubs armed with *four rows of suckers;* siphon valved, fastened to the head by bands; shell lancet form, with a hollow end, conus	Ommatostrephe (5)
Club arm armed with a combination of smooth-rimmed suckers and tubercles	Architeuthis (—)

(A gigantic group of cephalopods.)

(—) Family SEPIIDÆ.

Eyes covered by skin; littoral. Body oval, with long lateral fins, uniting behind; mantle supported by *cartilaginous tubercles*, fitting into sockets on the neck and siphon; arms with suckers; tentacular arms entirely retractile; siphon valved; shell (cuttle bone, sepion, or sepiostaire,) broad, flat, thickened internally by numerous plates, terminating behind in a hollow, imperfectly chambered, apex or mucro, without connecting siphon.

	Genus.
A lid-like fold under the eyes with lachrymal openings over them; six aqueous pores in the buccal membrane; arms short; tentacles long, suckers long, pedunculated; siphon with very large valve; fourth left arm hectocotylised to its base, (one or two species undetermined abundant in Tasmanian waters)	Sepia (—)
Differing from Sepia by the sessile arms having only two rows of suckers	Hemisepius (—)

(v.) Family SPIRULIDÆ.

Animal, body oblong, with minute terminal fins; mantle supported by a cervical and two ventral ridges and grooves; arms with six rows of minute cups; tentacular arms elongated; siphon valved; *shell* laxly spiral, pearly whorls on the same plane, not in connection, chambered; chambers connected by a ventral siphon, invested by a series of cone-shaped tubes, one for each chamber; shell is placed vertically in the end of the body, and is held in place by side flaps of the mantle.

	Genus.
Characters same as those of family	Spirula (7)

(B.) TETRABRANCHIATA.

Animal breathing by *two pairs* of symmetrical branchiæ; *eyes pedunculated*; mandibles *shelly*; arms very numerous, *without suckers*; shell external, chambered; capable of containing the animal.

(vi.) Family NAUTILIDÆ.

Septa simply curved, concave on the outer face; sutures simple, or undulate, or lobed; mouth simple; siphonal opening nearly central; shell often banded with colour, pearly inside. (Six living, and over 2,000 fossil species.)

Shell involute, discoidal few-whorled; septa concave, simple; siphuncle nearly central. Dist.—Tropical seas. Australia and Tasmania	Nautilus (8)

CLASS GASTEROPODA. (vii.-lxvii.)

Head distinct, usually furnished with eyes and tentacles; body mostly protected by a *spiral* or *conical univalve shell*; lower surface of animal developing a thickened, expanded, creeping disc or foot.

SUB-CLASS PROSOBRANCHIATA. (vii.-li.)

Sexes separate in different individuals. *Mostly marine animals*, provided with a shell and generally an operculum, embraces at least all operculated molluscs. Animals breathe by *gills or branchiæ.*

SUB-CLASS OPISTHOBRANCHIATA. (lii.-lvii.)

Marine slugs breathing by *arborescent or fasciculated branchiæ,* more or less exposed on back and sides posteriorly; a large division shell less, another possessing a spiral, conical or lamellar shell partly concealing branchiæ and itself *more or less concealed by mantle lobes. Sexes united.*

SUB-CLASS PULMONATA. (lviii.-lxvii.)

Mostly terrestrial (land shells), a portion being fluviatile (fresh water), usually provided with a *shell without operculum,* breathing air by the *simplest form of lung,* a pouch with external opening, lined with a net work of respiratory vessels. Sexes united in the same individual.

CLASS SCAPHOPODA. (lxviii.)

Shell or *hollow cylinder,* straight or curved without spire, open at both ends. Head rudimentary; foot vermiform, lobulate; nervous system simplified, resembling that of the pelecypods or lamellibranchs.

CLASS PELECYPODA. (lxix.-ci.)

(*Lamellibranchiata* Conchifera, Bivalves.)

No head nor eyes. Animals breathing by lamellæ, two on each side, mostly diæcious head with two chambers;

nervous system, gills with three principal pairs of ganglia. No sexual union, fertilisation being accomplished by the surrounding water containing the male element. Shell composed of two valves hinged together, but occasionally (Barnea) with smaller supernumerary pieces about the hinge.

Order Siphonida. (lix. to lxxxix.)

Animal *with siphons*, and mantle margins more or less closed; comprises most of the marine branchiæ, including a large portion of the old order *Dimyaria*—having *two well developed muscular impressions.*

	Sub. order.
Siphons *long*, partly or wholly retractile; the pallial impression upon the inside of valve *with a sinus.*	Sinupalliata (lxix. to lxxx.)
Siphons *short, not retractile*; pallial impression *simple without sinus.*	Integripalliata (lxxxi. to lxxxix.)

Order Asiphonida (xc.-ci.)

No siphons; pallial impression *without sinus*; mantle margin open.

	Sub. order.
Two muscular impressions equally distinct; mantle margins open or closed behind.	Homomyaria (xc. to xciii.)
Two unequal muscular impressions; *posterior* impressions *large*, anterior impression *very small*; frequently *inequivalve.*	Heteromyaria (xciv. to xcvi.)
A single posterior or sub-central adductor muscle and impression *only*	Monomyaria (xcvii. to ci.)

FAMILIES, GENERA AND SUB-GENERA.

(vii.) Family Muricidæ.

Shell spiral; turriculated with an *anterior* canal; the whorls thickened by varices or nodules at each rest period in its growth.

Genus Murrex. Linn. (9-11.)

Shell ovate or oblong; spire prominent; whorls convex crossed by three or more continuous varices; aperture ending below in a canal, which is generally partly closed.

Genus Urosalpinx. Stimpson. (12.)

Syn Adamsia, Agnewia.

Shell fusiform; not variced; longitudinally ribbed or undulated and spirally striated; aperture with a short canal; outer lip dentate, lirate within. Operculum semicordate, nucleus marginal.

Genus Typhis. Montfort. (13.)

Shell ovate or oblong, with *numerous projecting hollow tubular spines* between the three varices; aperture nearly round, produced in front into an *enclosed siphonal canal*; operculum ovate with apical nucleus.

Genus Trophon. Montfort. (14-22.)

Shell large, broadly fusiform, usually shouldered and umbilicate; with numerous lamelliform or laciniated varices, spire prominent; aperture ovate, lips thin; canal open, *usually turning to the left*; shell *white* without, but often dark within.

Genus Purpura. Bruguiere. (23-28.)

Syn.—Microstoma. Thais.

Shell oblong-oval, *last whorl large*; spire usually short; columella flattened; aperture ovate, large, terminating in a very short oblique channel, or notched; outer lip simple. *Dist.*—Low water to 25 fathoms.

(viii.) Family Tritonidæ.

(Shell with varices which are either few and irregularly distributed, or form a continuous row crossing the whorls on opposite sides.)

Genus Triton. Montf. (29-33.)

Syn.—Tritonium, Charonia, Aquilus, Lampusia, Ranularia

Shell oblong with prominent spire; whorls with a few remote non-continuous varices; columella rough or smooth; canal recurved; outer lip crenate or denticulate; operculum ovate with sub-marginal nucleus. *Dist.*—Low water to 50 fathoms.

Genus Ranella. Lam. (34-36.)

Shell ovate or oblong, compressed; varices two, continuous, one on each side; *columella arcuated, ridged or crenulate*; aperture oval; outer lip crenated; canal short, recurved; operculum ovate, horny, with lateral nucleus. *Dist.*—Reefs and deep water.

Family ix. FUSIDÆ.

(Shell more or less spindle-shaped, *without varices*; the lip of aperture not thickened.)

Genus FUSUS. Lamarck. (37-42.)

Shell fusiform, not variced; spire long, acuminate, many whorled; *columella smooth, without plaits*; aperture ovate, usually striate within; outer lip simple; *canal long and straight*; operculum ovate; acute, with apical nucleus; yellowish brown; sometimes with red brown strigæ or spots, never branded. *Dist.*—World-wide.

Genus FASCIOLARIA. Lamarck. (43-45.)

Shell fusiform; spire acuminate; aperture oval-elongate, outer lip internally crenate; columella smooth, *with a few oblique plaits*; canal moderate, nearly straight. *Dist.*—World-wide.

(x.) Family BUCCINIDÆ.

(Columella generally without folds or plications.)

Genus SIPHONALIA. Adams. (46-48.)

Shell ovately fusiform, sometimes variegately coloured, thin with very thin fugacious epidermis; last whorl ventricose, shouldered usually nodosely, plicate and spirally ribbed; aperture oval; outer lip thin; columella smooth; *canal rather short, twisted*; operculum ovate, with apical nucleus. *Dist.*—Japan, California, Australasia.

Genus CANTHARUS. Bolten. (49.)

Syn. Tritonidea.

Shell bucciniform, more or less ventricose in the middle, narrow anteriorly; *spire and aperture nearly equal*; columella generally with a few transverse ridges; outer lip internally crenated with a superior siphonal canal; operculum ovate, with apical nucleus.

Genus PISANIA. Bivona. (50-51.)

Shell oblong, with prominent spire; whorls smooth or spirally striated; canal very short; outer lip thickened and crenated; operculum ovate, with apical nucleus. *Dist.*—West Indies, Mediterranean, Philippines, Australasia.

Genus COMINELLA. Gray. (52-59.)

Shell bucciniform, marked or spotted, *covered with an epidermis*; spire short, acute; last whorl large, ventricose, with a *posterior depressed groove at the suture, producing a contraction at the hind part of the outer lip*; operculum with apical nucleus. The sub-genus *Josepha*, T.-Woods, differs from Cominella in possessing a plait upon the columella. *Dist.*—Cape, Australasia.

Genus Eburna. Lam. (60.)

Shell ovate-oblong, thick, porcellanous, under a thin epidermis; *deeply umbilicated*; spire acuminated; whorls more or less convex, *suture more or less channeled*; columella arcuated; callous posteriorly; aperture oval, inner lip spreading, *often covering the umbilicus* in the adult; outer lip simple acute; operculum with apical nucleus. *Dist.*—Red Sea, India, Cape, Japan, China, Australasia.

(xi.) Family Nassidæ.

(Base of aperture with a notch or short recurved canal; inner lip callous.)

Genus Nassa. Lam. (61-65.)

Shell small, ovate; ventricose; body whorl variously sculptured; aperture ovate, with a short, reflected, truncated, anterior canal; inner lip smooth; *often widely spread over with enamel*, with a *posterior callosity* or blunt, dentiform plait; outer lip dentated, internally crenulated; margin of operculum, serrate or entire. *Dist.*—World-wide.

(xii.) Family Volutidæ.

Genus Voluta. Linn. (66-72.)

Shell ovate or sub-conical, thick, solid; *spire usually short*; (Shoulder of whorls often angulated, sometimes nodose or spinous, but not so characterised in the Tasmanian living species.) Aperture—extending the *greater length of shell*—long and rather narrow; columella with a callous deposit and *prominently plaited*; lip generally thickened, sometimes sub-reflected. *Dist.*—World-wide, Australia being the chief centre.

(xiii.) Family Mitridæ.

Genus Mitra. (73-86.)

Shell fusiform thick; spire elevated; *aperture small*, generally *less than half the length of the shell, narrow*, notched in front; columella *transversely, somewhat obliquely plicate;* outer lip thick, smooth within, not variced externally. *Dist.*—Tropical and sub-tropical; range low water to 80 fathoms.

(xiv.) Family MARGINELLIDÆ.

Genus MARGINELLA. Lam. (88-96.)

Shell smooth, bright; spire short or concealed; aperture obtuse or truncated in front; *columella plaited*; *outer lip* (of adult) *with a thickened marginal varix*; inner margin smooth or crenulate. *Dist.*—Tropical and sub-tropical.

Genus ERATO. Risso. (87.)

Shell obovate, polished; spire short, conical, distinct; aperture linear; *outer lip without varix*, but *thickened towards the middle*, and denticulate within; columella with *distinct plaits at the fore part*. *Dist.*—World-wide.

(xv.) Family OLIVIDÆ.

(Shells sub-cylindrical, porcellanous, brilliant in colour; columella lip, sutures and spire more or less covered with a callous deposit; outer lip simple, notched below.)

Genus OLIVELLA. Swainson. (97.)

Shell *small*, polished, sub-cylindrical, solid; *spire produced*, acute; suture canaliculate; aperture narrow behind, enlarged anteriorly; columella plicated in front, callous posteriorly; *operculum present*, thin, half ovate with apical nucleus. *Dist.*—N. America, China, Australasia, etc.

Genus OLIVA. Brug. (98.)

Shell oblong, sub-cylindrical, polished; *spire short*, *conical*; suture canaliculate; *aperture long*, *narrow*, anteriorly widely notched; columella obliquely plicate; sulcate or striate in front; callous posteriorly; outer lip simple; operculm wanting. *Dist.*—America, Africa, India, Polynesia, Australasia.

Genus ANCILLARIA. (99-101.)

Shell oblong, polished, sub-cylindrical; body whorly, swollen; sutures covered by enamel; aperture broadly effuse below; columella not umbilicated, with a few oblique anterior plaits; basal whorl marked with revolving grooves which terminate occasionally in a slight anterior lip projection or tooth; *operculum generally present*, *small*, *ovate*, *acute*. *Dist.*—Red Sea, Indian Ocean, Japan, West Indies, Australasia.

(xvi.) Family Columbellidæ.

Genus Columbella. Lam. (102-113.

Shell strombiform, mitriform, or fusiform (usually fusiform, with elevated spire in Tasmanian species), smooth, or longitudinally or transversely ribbed; internal lip excavated in middle, *crenulate or denticulate in front*; outer lip *inflected and internally thickened and crenulate in the middle*. *Dist.*—Mostly sub-tropical. (Oat shell.)

(xvii.) Family Cancellaridæ.

Genus Cancellaria. Lam. (114-117.)

Shell ovately fusiform, *cancellated*, reticulated or ribbed; last whorl ventricose; aperture oblong, canaliculate in front; canal short, sometimes recurved; *columella with several large oblique plications*; operculum wanting. *Dist.*—World-wide; range, low water to 40 fathoms (vegetable feeders).

(xviii.) Family Terebridæ. (Auger Shells.)

Genus Terebra. Lam. (118-123.)

Shell *elongate, narrow, turriculate*, solid; whorls flattish, numerous, with superficially impressed sutures; aperture *small, ovate*. Profoundly notched at the base; columella oblique; operculum annular, horny, with apical nucleus. *Dist.*—Mostly tropical.

(xix.) Family Pleurotomidæ.

Genus Pleurotoma. Lam. (124-152.)

Shell turriculated, fusiform, *terminated anteriorly* by a straight canal, more or less prolonged; aperture generally linear-ovate; columella smooth, straight, or sinuous; outer lip *somewhat sinuous, with a notch or slit near the suture*; operculum corneous, annular, not always present. *Dist.*—World-wide; low water to 100 fathoms.

Sub-Genus Drillia. Gray.

Turriculated; aperture oval, oblique, about one-third the length of (adult) shell; canal short, twisted; columella lip strongly callous above.

Sub-Genus Bela. Gray.

Shell oval, fusiform; spire produced; canal short; sinus small near the suture; columella flattened; aperture narrowly ovate, nearly half the length of shell; *operculum pointed at both ends.*

Sub-Genus CLATHURELLA. Carp.

Differs from *Mangelia* in the more ventricose form and more evident canal; from *Clavatula* in the emargination of outer lip; from *Bela* and *Daphnella* in texture and sculpture; shell fusiform or turriculate, cancellated surface; columella lip without callosity, except a small posterior tooth; *no operculum;* aperture nearly half the length of (adult) shell.

Sub-Genus DAPHNELLA. Hinds.

Shell fusiform, *thin, fragile, usually striated;* aperture elongated, oval, usually less than half the length of (adult) shell; canal very short. Small and elegant shells, distinguished from *Defrancia* by their elongated body-whorl tenuity and sculpture. No operculum.

Sub-Genus CITHARA. Schum.

Shell fusiform, *polished, longitudinally ribbed*; aperture linear, truncated in front, slightly notched behind; outer lip *margined, denticulate within*: *inner lip frequently finely striate*; no operculum.

Sub-Genus MANGELIA. Leach.

Shell fusiform, mostly longitudinally ribbed; spire elongated, turriculate, accuminate; canal short, more or less truncate; columella smooth; aperture usually fully half the length of shell; sinus near the suture; no operculum.

(xx.) Family CONIDÆ.

Genus CONUS. Lam. (153-157.)

Shell thick, obconic; whorls enrolled upon themselves; spire not elevated or short, smooth or tuberculate; aperture elongate, narrow, margins parallel, truncate at base; outer lip with a slight suttural sinus. *Dist.*—Principally developed in the equatorial region.

(xxi.) Family CYPRÆIDÆ.

(Shell *convolute, enamelled*; *spire concealed*; aperture narrow, channeled at each end; no operculum.)

Genus CYPRÆA. Linn. (158-164.)

Shell ventricose, *convolute, covered with shining enamel*; *spire concealed*; aperture long, narrow, with short canal at each end; *inner lip crenulated;* outer lip *inflected* and crenulated.

Sub-Genus TRIVIA. Gray.

Distinguished by being striated over the back, frequently interrupted by an impressed dorsal sulcus.

Sub-Genus CYPRÆ-OVULA. Gray.

Pyriform, oval, ventricose. Surface covered with revolving striæ.

Genus OVULUM. Brug. (165.)

Shell ventricose, convolute, *attenuate, and sub-acuminate at both ends*; outer lip of adult thickened and inflected.

Sub-Genus VOLVA. Bolten.

Distinguished by being ventricose *in middle*, and in having both extremities prolonged into canals.

(xxii.) Family CASSIDIDÆ.

Genus CASSIS. Lam. (166-170.)

Shell sub-globular or triangular, usually solid, thick (Tasmanian species excepted), last whorl large, varicose; aperture longitudinal, narrow; outer lip *with a thickened, reflected margin, dentate within*; inner lip rugosely plicate; operculum oval, narrow, with median apex. *Dist.*—Mostly tropical and sub-tropical; voracious, living in sandy localities, preying upon bivalve molluscs.

Sub-Genus SEMICASSIS. Klein.

Shell oval, with revolving ribs; spine moderate, sharp.

Sub-Genus CASMARIA. H. and A. Adams.

Shell *generally* smooth; *whorls simple or sub-plicate,* spire moderate; inner lip smooth, callous; outer lip margined, smooth or slightly crenulated on the inner edge.

(xxiii.) Family NATICIDÆ.

(**Shell** globular or oval; spire, usually short; aperture, semilunar, *without canal* or *anterior notch*; outer lip sharp; *columella callous, more or less reflected over the umbilicus*; operculum pauci-spiral, corneous, or with an exterior calcareous layer.)

Genus NATICA. Lam. (171-177.)

Shell sub-globular; spire slightly elevated; aperture half round. A *spiral columella callus entering the umbilicus. Dist.*—World-wide.

Sub-Genus MAMILLA. Schum. (RUMA, H. and A. Adams.)

Shell ovate, conic, *rather thin*, with pointed spire; whorls fasciated; mouth *oblong*; inner lip narrow, reflected; umbilicus *not funiculated*.

Genus SIGARETUS. Lam. (178.)

Shell *ear-shaped*, with minute spire, and very large aperture, externally *with revolving striæ*; colour usually white, with sometimes a thin corneous epidermis; operculum minute, horny, sub-spiral. *Dist.*—United States, West Indies, China, Peru, Australasia.

Genus LAMELLARIA. Montagu. (179.)

Shell *ear-shaped*, *thin*, *pellucid*, *fragile*; spire very small; aperture large, patulous; inner lip receding; no operculum. *Dist.*—Norway, Great Britain, Mediterranean, New Zealand, Philippines.

(xxiv.) Family CALYPTRÆIDÆ.

(Shell *limpet-like*, with the apex more or less spiral; interior simple, or divided by a shelly process or plate, variously shaped, to which the adductor muscles are attached.)

Genus INFUNDIBULUM. Montfort. (180.)

Syn.—Trochita, Clypeola, Trochella.

Shell conic trochiform, spiral; summit central; whorls convex, plicate not umbilicated; aperture large, containing a spiral, transverse lamina or plate, extending obliquely from the centre to the outer margin of the shell. *Dist.*—Mostly tropical and sub-tropical.

Genus CALYPTRÆA. Lam. (182.)

Shell conical, more or less angular, with sub-central sub-posterior sharp apex; aperture basal, with a central lamina, half-cup shaped, attached to apex and open in front. *Dist.*—World-wide.

Genus LEGRANDIA. Beddome. (181.)

Shell *emarginuliform*; internal plate like *Crepidula*; radiately ribbed; *front edge fissured*. *Dist.*—Tasmania.

Genus CREPIDULA. Lam. (183-184.)

Shell oval, *limpet-like*, with a posterior generally lateral spiral apex; interior with a shelly plate covering its posterior half. *Dist.*—World-wide.

Genus HIPPONYX. Defrance. (185-187.)

Shell thick, obliquely conical, *non-spiral*; apex somewhat posterior and curved backwards; *muscular impression, horse-shoe shaped*; base of attachment shelly. *Dist.*—Almost world-wide.

Sub-Genus AMALTHEA. Schum.

Like Hipponyx, but *without shelly* base; impression *crescent-shaped.* This form is usually found attached to living shells.

(xxv.) Family SOLARIIDÆ.

(Shell *orbicular, depressed, or trochiform*; aperture generally angular; umbilicus usually wide and deep; operculum corneous, spiral.)

Genus SOLARIUM. Lam. (188-189.)

Shell depressed, conical, angular at periphery; aperture, subquadrangular, lip simple; umbilicus wide, spiral, its margins crenulated; operculum horny, sub-spiral. *Dist.*—Tropical, world-wide.

Genus ADEORBIS. S. Wood. (190.)

Shell *depressed*, orbicular, widely umbilicated; *whorls not numerous*, smooth or striate, the last somewhat angular; *aperture rounded*, the outer lip arcuate, simple, sharp; operculum shelly, sub-spiral. *Dist.*—West Indies, China, Australasia.

(xxvi.) Family SCALARIDÆ.

Genus SCALARIA. Lam. (191-202.)

Shell mostly white and lustrous; turreted; many whorled; whorls round, sometimes separate, *ornamented with numerous transverse ribs;* aperture round; *peristome continuous;* operculum horny, few whorled. *Dist.*—Mostly tropical.

Sub-Genus CROSSEA. A. Adams.

Shell *turbinate, umbilicated, white;* whorls convex, *cancellated, simple or with varices;* aperture roundish, anteriorly angular, somewhat produced and canaliculate; umbilicus surrounded and narrowed by a callus. Occurs also fossil in Australia and Tasmania, in rocks of Eocene age.

(xxvii.) Family IANTHINIDÆ.

Genus IANTHINA. Lam. (203-205.)

Shell thin, *translucent, trochiform or globular-turbinate; nucleus minute, styliform, sinistral;* whorls few, rather ventricose; aperture four sided; columella tortuous; lip thin, notched at the outer angle; base of the shell deep violet; spire nearly white. *Dist.*—Pelagic in Atlantic and Pacific Oceans.

(xxviii.) Family TURRITELLIDÆ.

Genus TURRITELLA. Lam. (206-210.)

Shell *elongated, awl-shaped,* many whorled, with revolving striæ; *aperture rounded;* operculum, many whorled, with a fimbrated margin, usually whitish or brownish, with sometimes red-brown spots or flames. *Dist.*—World-wide, ranging from Laminarian Zone to 100 fathoms.

(xxix.) Family VERMETIDÆ.

(G.) Shell (adult) *irregularly spiral, or contorted tubular;* operculate.

Genus VERMETUS. Adamson. (211.)

Shell irregularly spiral, adult stage, or contorted, tubular, operculate. *Dist.*—Tropical and sub-tropical. World-wide.

Genus SILIQUARIA. Brug. (212-213.)

Shell tubular: spiral at first, afterwards irregular; *tube with a continuous slit;* operculum spiral.

(xxx.) Family EULIMIDÆ.

(*Shell turriculated or turbiniform, smooth, milk white, polished;* aperture oval or rounded, sometimes angular in front; *columella without plications;* operculum corneous, sub-spiral, when present.

Genus EULIMA. Risso. (214-220.)

Shell small, white and polished; slender, elongated, with numerous level whorls; spire often curved to one side; *obscurely marked on one side by periodic mouths,* which form prominent ribs internally; *apex acute;* aperture oval, pointed above; outer lip thickened internally; inner lip reflected over the pillar; not umbilicated; operculum horny, sub-spiral. *Dist.*—World-wide—5 to 90 fathoms.

Genus STYLIFER. Brod. (221.)

Syn.—Stylina.

Shell *hyaline*, pellucid, thin, globular or subulate, smooth, polished; whorls numerous; apex very sharp, sometimes bent; *nucleus sinistral*; aperture sub-oval, angulated posteriorly, rounded in front; inner lip smooth, arcuated; outer lip slightly sinuous, thin, simple, no operculum. *Dist.*—Europe, West Indies, Polynesia, Australasia.

(xxxi.) Family TURBONILLIDÆ.

(Shell *white*, *slender*, *elongated*, many whorled, *mostly longitudinally ribbed or spirally striate.)*

Genus TURBONILLA. Risso. (222-225.)

Shell slender, elongated, many whorled; whorls plaited; *apex sinistral;* aperture simple, ovate; *peristome incomplete; columella not plaited*; operculum horny, sub-spiral. *Dist.*—World-wide. Range from low water to 90 fathoms.

Genus ACLIS. Lovén. (226.)

Shell *minute*, *like Turritella;* usually spirally striated; apex sinistral; aperture oval; outer lip prominent; axis slightly rimate, operculate. *Dist.*—Europe, North America, Australasia.

Genus ODOSTOMIA. Fleming. (227-229.)

Syn.—Odontostomia.

Shell subulate or ovate, typically smooth; apex sinistral; aperture *ovate*; peristome *not continuous*; columella *with a single tooth-like fold*; operculum horny, indented on the inner side. *Dist.*—Universal, from low water to 40 fathoms.

Sub-Genus PARTHENIA. Lowe.

Shell thin, turriculate, imperforate, usually milk white, under a very pale, thin, epidermis; whorls ribbed or striate, sometimes cancellate, vanishing at periphery of last whorl. *Dist.*—Japan and Tasmania.

Genus ELUSA. A. Adams. (230.)

Shell *subulate, turreted; whorls longitudinally plicate;* aperture *ovate;* inner lip with a single plait; outer lip often lirate within. *Dist.*—China, Japan, Australasia.

Genus SYRNOLA. A. Adams. (231-232.)

Shell subulate, *straight*, vitreous, *banded*, *polished;* whorls flat; *suture impressed*; aperture *oblong;* inner lip acute, *obliquely plicate in the middle ;* outer lip simple, acute.

Genus EULIMELLA. Forbes.

Sub-Genus STYLOPTYGMA. A. Adams. (233.)

Shell elongated, pupiform, turriculate, solid, smooth or slightly ribbed, polished; whorls inflated middle of spire, numerous; apex sinistral; aperture *sub-quadrangular. Dist.*—Europe, Japan, Australasia.

(xxxii.) Family LITTORINIDÆ.

(Shell spiral, *turbinate or globular;* peritreme entire; interior *not nacreous;* operculum corneous, spiral or or pauci-spiral.)

Genus LITTORINA. Ferussac. (234-238.)

Shell turbinated, thick, pointed, few whorled; aperture rounded; outer lip acute; columella rather flattened, imperforate, operculum, pauci-spiral. *Dist.*—Universal on sea shores.

Genus RISELLA. Gray. (239-241.)

Shell depressed, trochiform, with flattened whorls and keeled periphery; not umbilicated; aperture rhomboidal; marked with brown inside the margin; operculum pauci-spiral, distinguished from Trochus, which they resemble, by their non-nacreous interior. *Dist.*—Australasia, sea shore.

Genus FOSSARUS. Philippi. (242-244.)

Shell minute, turbinate, perforate, sculptured; inner lip thin; aperture semi-lunate; operculum not spiral. *Dist.*—Almost world-wide; among weed at low water.

(xxxiii.) Family PLANAXIDÆ.

Genus ALABA. H. and A. Adams. (245-247.)

Shell ovate, conical or elongated, *sub-diaphanous; whorls plicate or varicose;* apex sub-mammillate; aperture ovate, the columella more or less truncate. *Dist.*—Japan, West Indies, Australasia.

Sub-Genus DIALA. A. Adams.

Whorls *not varicose,* sometimes nodulate around the middle; columella *straightish, not truncated;* labrum not thickened. Dist.—Philippines, Japan, Australasia.

(xxxiv.) Family CERITHIIDÆ.

Shell spiral, elongated, many whorled, frequently varicose; *aperture channeled in front,* with a *less distinct* posterior canal; lip generally expanded in the adult; operculum, horny, spiral.

Genus CERITHIUM. Brug. (248-259.)

Shell turreted, many whorled, with indistinct varices; aperture small, *with a tortuous* canal in front; outer lip expanded; inner lip thickened; operculum horny, spiral. *Dist.*—Almost world-wide.

Sub-Genus BITTIUM.

Shell elevated, with numerous *granular* whorls and *irregular* varices; anterior canal short, *not recurved*; inner lip simple; outer lip *not reflected*; usually with an exterior rib; operculum four whorled.

Genus TRIFORIS. Deshayes. (260-261.)

Shell *sinistral*, sculptured, granular; whorls numerous, terminating below in a *small aperture with tubular anterior canal;* opposite this canal is sometimes a second one upon a varix, marking the position of a former aperture; operculum orbicular, few-whorled. *Dist.*—East Indies, Polynesia, Panama, West Indies, Mediterranean, Australasia.

Genus POTAMIDES. Brong. (262.)

Shell often large sized, *turriculated; whorls angulated and coronated;* aperture prolonged in front into a nearly straight canal; outer lip thin, *sinuous; epidermis thick*, olive brown; operculum many whorled. *Dist.*—Tropical and sub-tropical; fresh and brackish streams and swamps.

(xxxv.) Family RISSOELLIDÆ.

Genus TATEA. Tenison-Woods. (263.)

Shell minute, elongate, pyramidal, attenuate, with brownish-black epidermis; spire elevated, acuminate; whorls flattish (8); aperture pyriform; inner lip reflected; operculum horny and thin, with a vertical sub-marginal claw. *Dist.*—Only one representative, *T. Huonensis*, T. Woods. Found under stones at low water in tidal estuaries in Tasmania.

(xxxvi.) Family RISSOIDÆ.

Shell small, spiral, turreted or depressed, often more or less umbilicated; aperture more or less rounded, never truly channeled in front; peritreme continuous.

Sub-Family RISSOININÆ.

Shell small, ovate, or turreted with a thick corneous or calcareous pauci-spiral operculum, with internal process, *articulated (marine).*

Genus Rissoina. D'Orb. (264-274.)

Shell turreted, whorls numerous, *ribbed or cancellated;* aperture semi-lunar; lip slightly thickened within, somewhat expanded, faintly channeled anteriorly; operculum corneous, thick, semi-lunar, pauci-spiral *with an interior process. Dist.*—World-wide *(marine).*

Sub-Family Rissoinæ.

Shell small, ovate or elongate; operculum pauci-spiral, *not provided with an internal process (marine).*

Genus Rissoa. Frem. (275-289.)

Shell minute, white or horny, conical, pointed, many whorled; smooth, ribbed or cancellated; aperture rounded; peristome entire or continuous; *outer lip slightly expanded and thickened;* operculum sub-spiral. *Dist.*—Universal *(marine).*

Sub-Genus Setia. H. and A. Adams.

Shell thin, oval-oblong, or sub-conic; whorls few, ventricose spotted; spire short; apex obtuse; aperture sub-orbicular.

Sub-Genus Ceratia. H. and A. Adams.

Shell *sub-cylindrical, spirally striated,* white, thin, *sub-pellucid;* whorls rounded; summit of spire obtuse; aperture sub-oval; peristome continuous; *the outer lip thin and sharp.*

Sub-Genus Cingula. Fleming.

Shell thin, *elongated,* smooth or spirally striate, *spotted or banded;* aperture *pyriform or oval;* outer lip *sharp, with an external varix.*

Sub-Genus Alvania. Risso.

Shell *oval, turbiniform;* spire *rounded, usually cancellated;* aperture *sub-circular; crenulated within;* outer lip with a marginal exterior varix.

Sub-Family Hydrobiinæ.

Shell *very small,* or of moderate size, never exceeding two-fifths of an inch in length, globose, ovate or *elongated,* generally *umbilicated or rimate,* and *covered with a periostraca, for the most part of an olive colour;* whorls numerous (4-8) smooth or rarely ribbed or carinated; *never cancellated;* aperture more or less ovate or rounded, rarely sub-acute or effuse anteriorly; *peritreme continuous;* outer lip *usually simple and acute;* operculum pauci-spiral, corneous. *Dist.—Lakes, rivers* and *lagoons,* sea-level to 4,000 altitude; *mostly inhabiting fresh water* but some entering brackish water; herbivorous.

Genus HYDROBIA. Hartmann. (290-293.)

Shell minute, ovate or elongated, smooth, *sub-perforate*; spire conic; whorls generally flat; apex acute; aperture ovate; inner lip *not thickened*; operculum corneous; rostrum rather long; tentacles somewhat tapering but blunt at the extremity; foot somewhat pointed behind. *Dist.*—World-wide *fresh and brackish waters.*

Genus BITHYNELLA.? Moquin-Tandon. (294-303.)

Shell minute, elongated-ovate, usually somewhat pupiform, imperforate, or simply rimate; apex obtuse; aperture oval or rounded; peritreme continuous; outer lip sharp or slightly thickened; operculum corneous, nucleus moderately large, not very close to basal margin. Tentacles tapering blunt at the tip; foot rather narrow, rounded behind; very bifid. *Fresh water*, ascending to 4,000 feet altitude in Tasmania. *Dist.*—Europe, America, Australasia ?

Genus POTAMOPYRGUS. Stimpson.

Shell ovate-conic, imperforate; apex acute; whorls coronated with spines: aperture ovate; outer lip acute; operculum corneous; rostrum moderate; tentacles very long, slender, tapering, and pointed; eyes on very prominent tubercles; foot rather short, broadest in front, and strongly auriculated. *Dist.*—Fresh water, New Zealand, Tasmania, Cuba.

Genus POTAMOPYRGUS.? Hutton *non* Stimpson. (294-303.)

Shell ovate-conic or oval, imperforate; body whorl more than half the length of shell; aperture ovate, the outer lip acute; peritreme continuous or discontinuous; operculum horny, sub-spiral, without any internal process. *Animal* with the foot rather short, broadest, and slightly expanded in front; tentacles very long, slender, tapering and pointed; eyes on very prominent tubercles. *Dentition*, median tooth trapezoidal; inferior margin more or less trilobate; first lateral broad and excavated in the middle, contracted into a long peduncle, the denticles nearly equal; second lateral pointed at the inner extremity; the shank broad and thickened on its outer margin; third lateral with the inner extremity broad and rounded, constructed at its junction with the very broad shank which is thickened on its outer margin. Number of transverse rows of teeth, 55 to 69. Formula of the denticles $\frac{7 \text{ or } 9}{3 \text{ or } 4-3 \text{ or } 4}$; 9 or 11; 20 to 23; 30 to 40. Hutton's new definition of *Potamopyrgus* would exactly fit the numerous species in Australia, Tasmania, and New Zealand, hitherto variously assigned to *Paludestrina*, *Amnicola*, and latterly *Bithynella*. It is doubtful, however, whether the greatly modified definition may not have the effect of severing some of the original forms embraced under Stimpson's original definition of Potamopyrgus. A new name, say *Huttonia*, for the Australian, Tasmanian, and New Zealand forms, with the definition given by Professor Hutton, is suggested as the best course to adopt in the classification of Australasian species determined by the dentition characteristics.

Genus BRAZIERIA. Petterd. 1888. (304.)

Shell minute, globosely rounded, *solid*, *imperforate;* spire small; body whorl large; *aperture very oblique;* outer lip acute; inner lip thickened; operculum horny, sub-spiral. Animal very similar to *Beddomeia Launcestonensis*, Johnston. *Dist.*—Fresh water streams, North-Western Tasmania—River Wye, Surrey Hills, and tributaries of the Arthur River. The shell originally described by Tenison-Woods as *Ampullaria Tasmanica*, and later transferred to genus *Amnicola*, is here provisionally referred to Petterd's new genus, *Brazieria*.

Sub-Genus BEDDOMEIA. Petterd. 1888. (305-310.)

Shell globosely conical, thin, umbilicate or sub-umbilicate; spire short; body whorl inflated; aperture ovate; columella margin more or less thickened; operculum horny, pauci-spiral. Animal with a somewhat broad foot; *tentacles* long, *slender and pointed*; eyes sessile at outer base of same; muzzle broad and projecting. Dentition as in *Potamopyrgus*, Hutton *non* Stimpson, but the trapezoidal median tooth has quite a different arrangement of the inferior basal row, which consists of two ovate elevations on either side of a curved central tooth.

Formula of denticles on median tooth - $\frac{7 \text{ or } 9}{2-1-2.}$

Formerly the writer doubted the wisdom of erecting a new genus for the forms now included as above; but if the difficulty of the alteration of Stimpson's genus Potamopyrgus be surmounted, or if the name *Huttonia*, as suggested, be adopted for Professor Hutton's new definition as applied to Australasian forms, there is little doubt but that the sub-genus erected by Mr. Petterd would be most fitting for Australasian forms of this group.

Sub-Family POMATIOPSINÆ.

(Shell and operculum as in Rissoinæ. Foot with lateral sinus. Amphibious.)

Genus POMATIOPSIS. Tryon. (311-312.)

Shell elongated, frequently decollated, perforate, smooth; *whorls very convex*; aperture round; peristome continuous, slightly expanded or reflected. *Air breathing animal, preferring damp location in the vicinity of streams or lagoons. Dist.*—United States, Central America, Australia, Tasmania, Flinders' Island.

(xxxvii.) Family ASSIMINIIDÆ.

Genus ASSIMINEA. Leach. (313.)

Shell small, oval, conical, with moderate spire; aperture rounded, oval, with sharp lip entire; columella lip somewhat thickened. *Dist.*—Europe, Asia, America, Tasmania.

(xxxviii.) Family VALVATIDÆ.

Genus VALVATA. Müeller. (313^a.)

Shell depressed, conical (in the typical group), umbilicated; covered by a thin greenish epidermis; operculum orbicular, corneous, multispiral. Animal with a produced muzzle; tentacles long and slender, eyes at their bases; foot bilobed in front; branchial plume long, pectinated, partly exerted on the right side when the animal is walking; lingual teeth broad, uncini 3 lanceolate; all toothed and denticulated. *Dist.*—Freshwater, mundane.

(xxxix.) Family TRUNCATELLIDÆ.

Genus TRUNCATELLA. Risso. (314-317.)

Shell small, sub-cylindrical or turbinate, with elevated spire; apex obtuse or truncated; whorls striated transversely; aperture oval, entire; peristome continuous; operculum corneous, sub-spiral. Animal with short diverging tentacles; eyes centrally behind; head bilobed; foot short, rounded at each end. *Dist.*—On stones and seaweed *between tide marks.*

(xl.) Family NERITIDÆ.

Genus NERITA. Linn. (318.)

Shell *thick*, smooth or spirally grooved; epidermis horny; outer lip thickened and sometimes *denticulated within;* columella broad and flat, with its inner edge *straight and toothed;* operculum shelly. *Dist.*—Nearly all warm seas, living on rocks and stones at low water.

(xli.) Family Liotiidæ.

(Shell *depressed*, spiral, white ribbed, *sometimes cancellate*, or nodulous; aperture orbicular, rarely pearly within; operculum *corneous inside ;* outside with a calcareous coat of pearl-like shelly particles, spirally arranged.

Genus Liotia. Gray. (319-324.)

Shell turbinated or *depressed, varicose*, perforated or umbilicated whorls *ribbed or cancellated;* aperture rounded, *pearly within ;* peristome thick, callously margined. *Dist.*—Tropical and sub-tropical.

Genus Cylostrema. Marryat. (325-333.)

Shell orbicular, depressed, *widely umbilicated*, *spire short ;* whorls transversely *striated or cancellated ;* aperture round, *not nacreous ;* peristome continuous, simple. *Dist.*—Japan, Philippines, West Indies, Australasia.

(xlii.) Family Rotellidæ.

Genus Rotella. Lam. (334.)

Shell depressed, lenticular, the spire depressed, conical; aperture semi-orbicular; outer lip sharp; base with a convex rounded umbilical callus. *Dist.*—India, China, Japan, Philippines, Australasia.

(xliii.) Family Phasianellidæ.

Genus Phasianella. Lam. (335-339.)

Shell elongated, polished, richly coloured ; *whorls convex ;* aperture oval, *not pearly ;* inner *lip callous, outer thin ;* operculum shelly, callous outside, sub-spiral inside. *(Pheasant-shell.)* *Dist.*—Large species, Australasia; small species, India, Philippines; very small species, West Indies, Mediterranean, Great Britain.

(xliv.) Family Turbinidæ.

Genus Turbo. Linn. (340-342.)

Shell spiral, turbinated, solid, *nacreous inside ;* whorls convex, smooth, grooved or tuberculated; aperture *large, rounded*, slightly produced in front; operculum *shelly and solid*, callous outside and smooth, or variously grooved and mamillated, internally horny and pauci-spiral. *Dist.*—World-wide; rocks and weeds at low water, along the shore. (*Top-shell.*)

Sub-Genus TURBO. (Restricted.)

Shell smooth, or tuberculate, covered by a smooth epidermis; inner lip flattened, more or less produced in front; *no umbilicus*, operculum spiral on its inner face, convex and smooth or granular (*not ridged)* externally.

Sub-Genus SENECTUS. Humph.

Shell solid, with revolving squamose or spinose ridges covering the whorls; axis usually *narrowly perforated;* aperture usually slightly produced in front, with sometimes a short channel.

Sub-Genus MARMOROSTOMA. Swains.

Shell thick, smooth or tuberculate; aperture rounded in front; columella callus covering the axis, *which is umbilicated*, however; the umbilicus often *at the upper end of a curved channel in the callus;* operculum spiral, with central nucleus, and an indistinct sub-central external rib.

(xlv.) Family TROCHIDÆ.

(Shell usually conical, with *flattened base, nacreous inside;* operculum *corneous*, multispiral.)

Genus TROCHUS. Linn. (343-388.)

Shell pyramidal, with nearly a flat base; whorls, numerous, flat, variously striated; aperture oblique, rhombic, pearly inside; columella twisted, slightly truncated; outer lip thin; operculum, horny, multispiral. *Dist.*—World-wide; low water to 15 fathoms, the smaller species to 100 fathoms.

Sub-Genus TROCHUS. (Restricted.)

Umbilical region *excavated but not perforated;* columella *spirally twisted above*, terminating *in a point anteriorly.*

Sub-Genus INFUNDIBULUM. Mont. (CARINIDEA. Swains.)

Shell, conical; whorls *flattened, the last angular, base concave;* columella *without teeth*, or teeth obsolete.

Sub-Genus MINOLIA. A. Adams.

Shell globosely *conoidal*, widely and *profoundly umbilicated;* whorls rounded, clathrate; suture canaliculate; last whorl, subsolute towards the aperture; umbilicus perspective; aperture circular, pearly within; *peristome*, continuous, thin, acute.

Sub-Genus ASTELE. Swainson. (Tas. Journal, 1855.)

Shell nacreous, *pyramidal* or trochiform; unarmed; body whorl convex; columella, none; *umbilicus large*, closed only by the terminal whorl of the spire; aperture, broader than high, the margin of both lips thin.

Sub-Genus MONILEA. Swainson.

Shell *orbicular, depressed, widely umbilicated;* whorls encircled by grooves, the last rounded; umbilicus *encircled by a striated callus;* columella terminating anteriorly in one or two tubercles.

Sub-Genus GIBBULA.

Shell *conoidal, umbilicated; umbilicus cylindrical or infundibuliform;* whorls frequently tuberculated above, and with channeled suture; columella *sometimes* terminating in a tubercular tooth.

Sub-Class ZIZYPHINUS. Gray. (CALLIOSTOMA.) Swains.

Shell trochiform, conical, *not umbilicated;* last whorl *angulated* and usually *ribbed at the periphery;* aperture, *quadrangular;* columella simple, oblique, often ending in a tooth in front.

Sub-Genus THALOTIA. Gray.

Shell ovate-turriculated, rather thick, *not umbilicated;* whorls *flattened*, with revolving *ribs, which are sometimes granular;* aperture, sub-rotund; columella *tuberculate, truncate in front;* outer lip *rather thick, crenulated within.*

Sub-Genus ELENCHUS. Humphrey.

Shell elevated, conoidal, *spire sharp;* whorls *rather flat, smooth, polished,* usually *with distant revolving incised lines;* aperture *sub-oval;* columella with *a tooth-like projection in the middle;* outer lip thickened within. Brilliantly coloured shells, but very pearly within (used as ornamental necklaces by the Tasmanian Aborigines).

Sub-Genus CANTHARIDUS. Montfort.

Shell ovate, thin, outer lip acute; the columella wants the conspicuous tooth seen in *Elenchus;* the whorls are *encircled by striæ and not polished;* interior highly iridescent.

Sub-Genus BANKIVIA. Beck.

Shell *subulate,* with sharp spire, polished, bright coloured; whorls smooth, flattened, *without epidermis;* aperture sub-ovate, rather large, *not nacreous within;* columella twisted, truncated in front; outer lip simple, sharp.

Sub-Genus TROCHOCOCHLEA. Klein.

Shell elevated, turbiniform; whorls bluntly angled at the periphery, or with revolving carinæ; outer lip thin, smooth within; inner lip *spreading, twisted, dentate below, no umbilicus.*

Sub-Genus EUCHELUS. Phil.

Shell *conoidal, turbinate umbilicated*; whorls rounded, with *granulated* revolving ribs; columella lamellarly produced into a central tooth; outer lip thickened and *crenulate within*; opercular whorls rather few, rapidly increasing.

Sub-Genus CLANCULUS. Montfort.

Shell conoidal or turbinated, *not umbilicated*; whorls mostly *granulous*; aperture contracted; columella spirally twisted, forming a *false umbilicus, plicated throughout* and terminating in a *multi-dentate varix*; outer lip *dentate within*, with sometimes a larger superior tooth.

Sub-Genus DILOMA. Philippi.

Shell *conoidal, smooth, not umbilicated*; whorls rather few, *convex*; aperture sub-rotund; columella lip *excavated in the middle and expanded over the umbilicus region*, produced laterally to join the outer lip; outer lip thin, unarmed.

Genus MARGARITA. Leach. (—)

Shell *thin, globular, conical, umbilicated*; whorls rounded, smooth; aperture rounded, pearly; lip sharp, smooth. *Dist.*—Japan, California, Australasia.

(xlvi.) Family STOMATELLIDÆ.

Genus STOMATELLA Lam. (389.)

Shell *ear-shaped*, regular; spire small; aperture oblong, very large and oblique, *nacreous*; lip thin, even edged; operculum circular, *horny*, multispiral. *Dist.*—On reefs and under stones at low water.

Genus STOMATIA. Helbing. (390.)

Shell like *Haliotis, but without perforations*, their place being occupied by a *simple furrow*; surface rugose, smooth or spirally ridged; spire small, prominent; aperture *large, oblong;* outer magin irregular. *Dist.*—Java, Philippines, Torres Straits, Pacific, Australasia.

Sub-Genus GENA. Gray.

Shell sub-spiral, *oblong, auriform, depressed*, smooth or striated; *spire flattened, nearly obsolete*; aperture very large; no operculum.

(xlvii.) Family PLEUROTOMARIIDÆ.

Shell more or less conically elevated, turreted or trochiform, *with a marginal slit* in the upper part of the outer lip, or a row of perforations in the upper part of the whorl; aperture often pearly within.

(lii.) Family PHILINIDÆ.

Genus PHILINE. Ascanias. (436.)

Shell *bulliform*, *not forming a single whorl*, internal, white. translucent, oval, slightly convoluted; spire rudimentary *Dist.*—West Indies, Boreal Atlantic, Mediterranean, East Indies, Australasia.

(liii.) Family TORNATELLIDÆ.

Shell *spiral*, *ovate*, *convolute* or involute, spire more or less elevated; surface mostly *spirally punctated*; aperture usually high and narrow, truncate or roundish in front; columella solid.

Genus TORNATINA. D'Orb. (437.)

Shell oval, elongated, conical or fusiform, with revolving punctated striæ; aperture long and narrow, widened in front, entire; lip sharp; columella thickened, but without plications. *Dist.*—Almost world-wide.

Genus RINGICULA. Desh. (438.)

Shell *minute*, ventricose, with small spire; aperture *notched*; columella callous, *deeply plaited*; outer lip *thickened and reflected*. *Dist.*—In all warm seas.

(liv.) Family CYLICHNIDÆ.

Shell external, spiral, *more or less cylindrical*; nearly white; no operculum.

Genus CYLICHNA. Lorén. (439-440.)

Shell strong, *cylindrical*, smooth, or punctate-striate; spire minute or truncated; aperture narrow, rounded in front; columella callous, with one plait. *Dist.*—Chiefly deep water shells, Greenland, Britain, Red Sea, Australasia.

(lv.) Family BULLIDÆ.

Shell spiral, *ventricose, rather thick, maculated* and *banded* in the typical genus, white in others; spire *involute*, external, but usually partly covered by the lateral lobes of the foot.

Genus BULLA. Linn. (441.)

Shell oval, globular, smooth, spotted, marbled or zoned; spire concave; aperture as long as the shell; inner margin without columella; outer lip trenchant. *Dist.*—Universal.

Genus HAMINEA. Linn. (442)

Shell oval, globular, spiral, ventricose, *corneous*, thin, covered by a slight *smooth epidermis*; spire involute; lacks the colours of Bulla.

(lvi.) Family LOPHOCERIDÆ.

Genus AKERA. Muller. (443.)

Shell like Bulla, thin, flexible, globosely cylindrical; spire truncated; whorls channeled; aperture long, expanded and deeply sinuated in front; outer margin disunited at the suture; columella open, exposing the whorls. *Dist.*—Greenland, Great Britain, Mediterranean, East Indies, Australasia.

(lvii.) Family APLYSIIDÆ.

Shell wanting or rudimentary, and covered by the mantle; *oblong, trigonal or slightly convoluted*; large, slug-like animals.

Genus APLYSIA. Gmelin. (444-445.)

Shell oblong, convex, *flexible and translucent*, with a posterior slightly incurved apex. (Sea-hare.) *Dist.*—West Indies, Norway, Britain, Mediterranean, Mauritius, China, Australasia.

(lviii.) Family VITRINIDÆ. (Land Shells.)

Shell usually thin, corneous, transparent, spiral, of *few rapidly enlarging whorls*.

Genus VITRINA. Drap. (446-448.)

Shell imperforate, very thin, depressed; spire short, last whorl large; aperture large, lunate or rounded; columella margin slightly inflected; peristome often membranous. *Dist.*—Universal, mostly inhabit cold or temperate countries or mountain regions of warm countries.

(lix.) Family HELICIDÆ. (Land Shells.)

(Shell spiral, usually thicker than in the Zonitidæ, and mostly with reflected lip, the aperture edentulous or contracted by teeth.)

Genus HELIX. (449-518.)

Shell of variable form, smooth, rugose, striate, ribbed or tuberculate, sometimes pilose; orbicular convex, planorbid, trochiform subturriculated, or short buliminiform (monstrosities sinistral, or with the whorls more or less uncoiled); aperture oblique, oval or semi-lunar, with or without interior teeth on the margin or parietal wall; lip simple or thickened internally or reflected, umbilicus covered, widely open. *Dist.*—Universal.

Genus Bulimus. (519-520.) Land Shells.

Shell *oval-oblong* or *turriculated*, solid, sub-perforate or imperforate; whorls few, the last ventricose and large; aperture longitudinal; columella widened, rarely plicate; peristome thickened, reflected; the lip usually joined by a callus. *Dist.*—Mostly South American.

(lx.) Family Pupidæ. (Land Shells.)

Shell generally *minute*, multispiral, cylindrical, with obtuse summit (pupiform); *aperture small*, usually contracted by internal teeth or lamellæ.

Genus Pupa. (521.)

Shell usually *very small, cylindrical or oval*-oblong; umbilicus slight or a mere slit; plicate, striate or costellate brown or horn-colour; columella *plicate or sub-dentate; lip reflected*, usually dentate or plicate within, the extremities usually joined by a raised callus. *Dist.*—Universal, boreal and tropical.

(lxi.) Family Limacidæ. (Terrestrial Land Slugs.)

Shell *rudimentary, a calcareous plate, not spiral*, concealed under the mantle, and covering the respiratory cavity.

Genus Limax. (522.)

Shell-plate *testaceous thin, flat*, longer than wide, with concentric striæ of increase, internal. *Dist.*—Universally distributed.

(lxii.) Family Arionidæ.

(*Animal naked*, with or without mucous pore; mantle concealing a shell-plate, or a few calcareous grains which represent it; jaw strongly ribbed; central tooth tricuspidate, the median cusp long and narrow; laterals and marginals bicuspidate.)

Genus Cystopelta. (523.)

Body attached for half its length to the back of the foot; mantle very large, enveloping the whole animal in repose, but from beneath which the head and the tip of the tail alone are visible from above when the animal is crawling; tentacles four; tail with a mucous spore at the tip; mandible like that of Arion; lingual teeth resembling those of Testacella. No shell. *Dist.*—Tate. Tasmania.

(lxiii.) Family SUCCINEIDÆ.

Genus SUCCINEA. (524-525.)

Shell oval, very fragile and transparent; spire short; the whorls few, and very rapidly enlarging; aperture oval; outer lip thin, not reflected, united below by a very broad curve with the thin, smooth columella. *Dist.*—World-wide; sub-aquatic, living in damp places, near the margin of streams.

(lxiv.) Family AURICULIDÆ.

(**Shell** oblong-oval, covered by a thin epidermis; spire short, conoidal, very rarely sub-elongated; last whorl large; rounded at the base; aperture longitudinal, narrow, ear-shaped; inner wall of the aperture with two or three plications, peristome thickened internally, without teeth.)

Genus CASSIDULA. (526-529.)

Shell sub-perforated, cassidiform, solid; spire short, conoidal; last whorl very large, attenuated to the base, where it is usually carinated or angulated around the axis; aperture narrow, sinuous; inner lip dentately plicate; columella plication strong; outer lip thickened within by a strong callosity with toothed edge. *Dist.*—Ceylon, East Indies, Philippines, Australasia, Polynesia.

Genus ALEXIA. (527.)

Shell oblong-oval, thin, spire acuminate; last whorl large, rounded at base; columella with an oblique plait; aperture contracted by teeth, and sometimes by a callosity of the outer lip. *Dist.*—United States, West Indies, Maderia, Europe.

Genus MARINULA. (528.)

Shell oval-oblong, imperforate, solid, smooth; spire short, sharp; aperture oval; inner lip rather thick, excavated with three plications, the posterior largest; outer lip simple, sharp. *Dist.*—Australia, Mediterranean, W. Coast of America.

Genus OPHICARDELUS. (529.)

Shell oval-oblong, umbilicated, smooth; spire elevated-conic; aperture oval, elongated, angulated above; inner lip reflected, with two spiral plications, one of which surrounds the umbilicus; outer lip thin, simple. *Dist.*—Australia, Polynesia.

(lxv.) Family LIMNÆIDÆ.

Shell thin, horn-coloured, mostly spiral, sometimes patelliform, capable of containing the entire animal, contracted; aperture simple, rounded; lip sharp.

Genus LIMNÆA. (530-533.)

Shell normally dextral, oval-oblong, thin, corneous, translucid; spire sharp, more or less acuminated; last whorl ventricose; aperture oval, ample, rounded in front; columella lip with an oblique plait entering above. *Dist.*—Europe, Asia, America, North of the Equator, Polynesia.

Genus AMPHIPEPLEA. (534-535.)

Shell globular, ventricose, thin, transparent; spire very short, depressed; aperture very large; columella without fold; outer lip sharp. *Dist.*—Europe, East Indies, Australia, Philippines.

Genus PHYSA. (536-547.)

Shell ovate, sinistrally spiral, thin, polished; aperture rounded in front. *Dist.*—North America, Europe, East Indies.

Genus PLANORBIS. (548-551.)

Shell discoidal, biconcave, the whorls visible on both sides; aperture small, rounded, margin usually simple, sometimes expanded. *Dist.*—World-wide.

Genus ANCYLUS. (552-554.)

Shell conical, limpet-shaped, thin; apex posterior turned to the left; aperture with entire basal margin; interior with a sub-spiral muscular scar. *Dist.*—North and South America, Europe, Australia.

Genus GUNDLACHIA. (555-556.)

Shell very small, thin, obliquely conic, apex inclined posteriorly and to the right; base two-thirds closed by a flat, straight-edged shelf, leaving a semicircular aperture. *Dist.*—United States, Cuba, Tasmania.

(lxvi.) Family AMPHIBOLIDÆ.

Genus AMPHIBOLA. (557-559.)

Shell sub-globose, rather thick, rugose, umbilicated; spire short, whorls shouldered above, umbilicated; aperture sub-oval; columella lip callous; columella flattened and reflected; outer lip sinuous posteriorly; operculum corneous, sub-spiral. *Dist.*—New Zealand.

(lxvii.) Family SIPHONARIIDÆ.

Genus SIPHONARIA. (560-562.)

Shell solid, porcellanous; apex central or sub-central; provided with more or less elevated radiating ribs or ridges, which by their projection render the margin irregular. *Dist.*—Cape, India, Philippines, Australia, New Zealand, Pacific, Galapagos, Peru, Cape Horn, West Indies, West Coast of North America.

CLASS SCAPHOPODA.

(lxviii.) Family DENTALIIDÆ.

Genus DENTALIUM. (563-564.)

Shell *tube-like*, gradually tapering posteriorly, longtitudinally ribbed, margin of the aperture sharpened, posterior end with an internal, slightly projecting tube, which is provided with a dorso-ventrally elongated opening; the outer layer having a very slight emargination dorsally and ventrally. *Dist.*—Universal.

CLASS PELECYPODA.

(*Lamellibranchiata. Conchifera.*)

(lxix.) Family GASTROCHÆNIDÆ.

Shell *equivalve*, gaping; valves *thin*, edentulous, united by a thin external ligament, sometimes *cemented to a shelly tube* when adult; adductor impressions 2, pallial line *sinuated*.

Genus ASPERGILLUM. (565.)

Shell small, equilateral, *cemented to the lower* end of a *shelly tube, the umbones alone visible* externally; tube elongated, closed below by a perforated disc, with a minute central fissure; siphonal end plain, or ornamented with ruffles. *Dist.*—Red Sea, Java, Australia, New Zealand; in sand.

Genus GASTROCHÆNA. (566.)

Shell *elongated, narrow*, contained within *a shelly tube*; posterior adductor nearly central, with a pedal star in front; siphonal inflection angular, with its apex joining the pallial line; tube round, straight, tapering upwards, transversely striated, closed at the lower end when complete, and furnished with a perforated diaphragm behind the valves. *Dist.*—Madagascar, India, Philippines, Australia; burrowing in sand or mud.

(lxx.) Family TEREDIDÆ.

Genus TEREDO. (567.)

Shell *globular*, open in front and behind, lodged at the inner extremity of *a burrow partly or entirely lined with shell*; valves *three lobed*, concentrically striated, and with one transverse furrow; hinge margins reflected in front, marked by the anterior muscular impressions; umbonal cavity with a long, curved, muscular process. *Dist.*—Norway, Britain, Black Sea, Tropics, Australasia. 119 fathoms.

(lxxi.) Family PHOLADIDÆ.

Genus BARNEA. (568.)

Shell *oval*, oblong, anteriorly gaping; with *a single* lanceolate *dorsal accessory valve*; umbonal process reflected, closely applied. *Dist.*—Australia, Burmah, Red Sea, Europe, Patagonia, Philippines.

(lxxii.) Family SOLENIDÆ.

Genus SOLEN. (569.)

Shell *very long*, *sub-cylindrical*, *straight*, margins parallel, ends gaping; beaks terminal, or sub-central; hinge teeth, one in each valve; ligament long, external; anterior muscular impression elongated; posterior oblong; pallial line extending beyond the adductors; sinus short and square. *Dist.*—World-wide, except Arctic Seas; 100 fathoms.

(lxxiii.) Family SAXICAVIDÆ.

Shell equivalve, *thick*, *gaping at the extremities*; hinge with a single cardinal tooth; ligament external, prominent, solid, inserted in a nymphal callosity; pallial impression *irregular*, *sinuous*.

Genus SAXICAVA. (570.)

Shell when young symmetrical, with two minute teeth in each valve; adult rugose, toothless; oblong, equivalve gaping; ligament external; *pallial line sinuated*, *not continuous*. *Dist.*—Universal.

Genus PANOPÆA. (571.)

Shell equivalve, thick, oblong, gaping at each end, ligament external *on prominent ridges*; one prominent tooth in each valve; *pallial sinus deep*. *Dist.*—Northern Seas, Mediterranean, Cape, Australia, New Zealand, Patagonia; low water—90 fathoms.

(lxxiv.) Family CORBULIDÆ.

Shell *small*, inequivalve, thick, *gaping in front*; hinge consisting of a single recurved tooth in one valve, received into a fosset or notch in the other.

Genus CORBULA. (572-573.)

Shell thick, *inequivalve*, *gibbose*, closed, produced posteriorly; right valve with a prominent tooth in front of the cartilage pit; left valve smaller, with a projecting cartilage process; pallial sinus slight; pedal scars distinct from the adductor impressions. *Dist.*—United States, Norway, Britain, Mediterranean.

Genus NEÆRA. (574.)

Shell *globular*, *attenuated*, and gaping behind; right valve a little the smallest; umbones strengthened internally by a rib on the posterior side; cartilage process spatulate in each valve (furnished with a movable ossicle—Deshayes), with an obsolete tooth in front, and a posterior lateral tooth; pallial sinus very shallow. *Dist.*—Norway, Britain, Mediterranean, Canaries, Madeira, China, Moluccas, New Guinea, Chili; from 12-200 fathoms.

(lxxv.) Family ANATINIDÆ.

Shell often inequivalve, *thin*, *interior nacreous*; surface granular; ligament external, thin; cartilage internal, placed in corresponding pits and usually furnished with a free ossicle; muscular impressions faint, the anterior elongated; pallial line usually sinuated.

Genus ANATINA. (575-578.)

Shell *oblong*, *ventricose*, sub-equivalve, *thin and translucent*, posterior side attenuated and gaping; umbones fissured, directed backwards, supported internally by an oblique plate; hinge with a spoon-shaped cartilage process in each valve, furnished in front with a transverse ossicle; pallial sinus wide and shallow. *Dist.*—India, Philippines, New Zealand, Japan, United States.

Genus MYODORA. (579-583.)

Shell *trigonal*, *rounded in front*, *attenuated and truncated behind*; right valve convex, left flat; interior pearly; cartilage narrow, triangular, between two tooth-like ridges in the left valve, with a free sickle-shaped ossicle; pallial line sinuated; structure like Anatina; outer cells large, rather prismatic. *Dist.*—New Zealand, New South Wales, Philippines.

Genus MYOCHAMA. (584-585.)

Shell inequivalve, *attached by the dextral valve, and modified* by the form of the surface of attachment; posterior side *attenuated*; *left valve gibbose*; cartilage internal, between two tooth-like projections in each valve, and furnished with a movable ossicle; anterior muscular impression curved, posterior rounded, pallial sinus small. *Dist.*—Australasia; attached to Crassatella and Trigonia in 8 fathoms water; the fry, (as indicated by the umbones) is free, regular and Myodora-shaped.

(lxxvi.) Family MACTRIDÆ.

Shell *equivalve*, *trigonal*, close or slightly gaping; ligament (cartilage) *internal*, sometimes external, contained in a *deep triangular pit; epidermis thick*; hinge with two diverging cardinal teeth, and usually with anterior and posterior laterals; pallial sinus short, rounded.

Genus MACTRA. (586-588.)

Shell nearly *equilateral*; anterior hinge-tooth Λ shaped, with sometimes a small laminar tooth close to it; lateral tooth doubled in the right valve. *Dist.*—All seas, especially within the tropics; 35 fathoms.

Genus LUTRARIA. (589.)

Shell *oblong*, *gaping at both ends*; cartilage plate prominent, with 1 or 2 small teeth in front of it in each valve; pallial sinus deep, horizontal. *Dist.*—United States, Brazil, Britain, Mediterranean, Senegal, Cape, India, New Zealand, Sitka.

(lxxvii.) Family PAPHIIDÆ.

Genus PAHIA. (590-595.)

Shell *trigonal*, *thick*, *compressed*, closed; ligament *internal*, *in a deep*, *central pit*; a minute interior hinge-tooth, and 1—1 lateral teeth in each valve; muscular scars deep; pallial sinus small. *Dist.*—West Indies, Mediterranean, Crimea, India, New Zealand, Tasmania, Chili; sands at low-water.

Sub-Genus MESODESMA. Desh.

Shell *oval*, *sub-equilateral*; lateral teeth short, smooth, sub-equal; siphonal inflection distinct.

Sub-Genus DONACILLA. Lam.

Shell *elongate*, *cuneiform*, slightly *truncate posteriorly*; anterior lateral teeth *elongated*; posterior short; siphonal sinus distinct.

Sub-Genus ANAPA. Gray.

Shell *sub-trigonal, ventricose,* truncate posteriorly; lateral teeth sub-equal, compressed, smooth; siphonal inflection *obsolete.*

(lxxviii.) Family SEMELIDÆ.

Genus SEMELE. (596-598.)

Shell *rounded, sub-equilateral, beaks turned forward*; posterior side *slightly folded*; hinge-teeth 2·2, laterals elongated, distinct in the right valve; external ligament short, cartilage internal, long, oblique; pallial sinus *deep, rounded. Dist.*—West Indies, Brazil, India, China, Australasia, Peru.

(lxxix.) Family TELLINIDÆ.

Shell *free, compressed,* usually closed and equivalve; cardinal teeth, 2 at most, laterals 1—1, sometimes obsolete; muscular impressions rounded, polished; pallial sinus very large; ligament on shortest side of the shell; external structure obscurely prismatic-cellular; prisms fusiform, nearly parallel with surface, radiating from the hinge in the outer layer, transverse in the inner.

Genus TELLINA. (599-606.)

Shell slightly *inequivalve, compressed,* rounded in front, angular and slightly folded posteriorly, umbones sub-central; teeth 2·2, laterals 1—1, most distinct in the right valve; pallial sinus very *wide and deep;* ligament external, prominent. *Dist.*—In all seas, especially the Indian Ocean. Most abundant and highly coloured in the Tropics. Low water—coral zone, fifty fathoms. Wellington Channel, Kara Sea, Behring's Straits, Baltic, Black Sea.

Genus GARI. (607-609.)

Shell transverse, *oval-oblong, flat,* equivalve, sub-equilateral, *concentrically plicate,* a little gaping on each side and covered by a *thin epidermis;* hinge narrow, with two small cardinal teeth, sometimes bifid, in each valve; beaks small; ligament long and prominent; margins simple; muscular impressions rather large, equally distant from the hinge, the anterior oblong, the posterior rounded; pallial impression distant from the margin, with a *narrow, profound* sinus. *Dist.*—Norway, Britain, India, New Zealand, Pacific; littoral—coralline zone, 100 fathoms. *G. Gari* is eaten in India.

Genus HIATULA. (610-611.)

Valves *oval-oblong*, *compressed*, ventral margin usually *incurved* posteriorly, where the valves are attenuated; broadly rounded anteriorly; beaks sub-median, not prominent, violaceous, under an olive epidermis; ligament thick, swollen; one or two very small cardinal teeth in each valve; muscular impressions rounded, distant; pallial impression *very sinuous*. *Dist.*—W. Indies, Red Sea, India, Madagascar, Japan, Australia, Tasmania, Peru.

(lxxx.) Family VENERIDÆ.

(Shell *regular*, *closed*, *sub-orbicular or oblong;* ligament external; hinge with usually three diverging teeth in each valve; muscular impression oval, polished; *pallial line sinuated.*)

Genus VENUS. (612-623.)

Shell thick, *ovate*, smooth, sulcated, or cancellated; margins minutely crenulated; cardinal teeth 3·3; pallial sinus *small*, *angular ;* ligament prominent; lunule distinct. *Dist.*—World-wide. Low water, 140 fathoms. *V. Astartoides*, Behring's Sea. *V. Verrucosa*, Britain, Mediterranean, Senegal, Cape, Red Sea, Australia ?

Sub-Genus CHIONE. Megerle. (MURCIA, Romer. OMPHALOCLATHRUM. Klein.)

Shell *oval*, *triangular* or *sub-cordiform ; margins finely crenulated ;* hinge narrow, solid, with *three teeth in the right* valve, *two in the left*, the anterior tooth longest; ligament narrow; pallial sinus *shallow*. Mantle-margins folded and dentate; siphons short, unequal, the branchial doubly cirrated, the anal ciliated.

Genus CYTHEREA. (624-631.)

Shell like Venus; oval-triangular, smooth; margins simple; hinge with *three cardinal teeth* and an *anterior tooth beneath the lunule ; pallial sinus moderate*, *angular*. *Dist.*—Same as Venus. Recent. 150 sp.

Sub-Genus CALLISTA.

Shell oval, *transverse*, *inequilateral ;* pallial sinus sub-oval, profound. Mantle-margins folded and cirrous above the siphons; siphons united, cirrated at their extremities.

Sub-Genus GOULDIA.

Shell *sub-trigonal*, *oval*, *shining*, *inflated*.

Genus DOSINIA. (632-636.)

Shell *orbicular*, *compressed*, *concentrically striated*, pale, ligament sunk; lunule deep; hinge like Cytherea, margins even; pallial sinus *deep*, *angular*, ascending. *Dist.*—Boreal, Tropical Seas. Low water, 80 fathoms.

Sub-Genus GOULDIA.

Shell sub-trigonal, oval, smooth, shining, inflated.

Genus TAPES. (637.)

Shell *oblong*, umbones anterior, margins smooth; teeth, three in each valve, *more or less bifid;* pallial sinus *deep*, *rounded*. *Dist.*—Norway, Britain, Black Sea, Senegal, Brazil, India, China, New Zealand. Low water, 100 fathoms.

(lxxxi.) Family CYRENIDÆ.

Shell *sub-orbicular*, closed, ligament external; *epidermis thick*, *horny;* umbones of aged shells eroded; hinge with two or three cardinals and lateral teeth; pallial line with a *small inflection.*

Genus CORBICULA. (638.)

Shell sub-cordiform, solid, close, concentrically striated or rigid, covered by a smooth, greenish epidermis; three cardinal teeth in each valve, the right anterior and left posterior rather small; lateral teeth elongated, compressed, striated; ligament prominent, thick; pallial impression with a slight or well-marked sinus. *Dist.*—India, East Indies, Philippines, S. America.

Genus PISIDIUM. (639-640.)

Shell *sub-oval*, *trigonal*, inequilateral, covered by a greenish *epidermis;* cardinal teeth very small, elongated, one sometimes bifurcated in the right valve, two diverging in the left valve; lateral teeth longitudinal, compressed, lamelliform, double in the right valve. *Dist.*—Universal. *Fresh water lakes and rivers*, Tasmania.

Genus SPHÆRIUM. (41.)

Syn. Cyclas.

Shell thin, *oval or sub-orbicular*, inflated, covered by a *greenish epidermis;* cardinal teeth very small or rudimentary, one more or less bifurcated, one in the right and two oblique ones in the left valve; lateral teeth compressed, lamelliform, the anterior shortest; ligament short; margins plain, muscular impressions scarcely apparent, sub-marginal; pallial impression simple. *Dist.*—Universal.

(lxxxii.) Family PETRICOLIDÆ.

Genus RUPELLARIA. (642-647.)

Shell *elongated*, moderately tumid, *surface rugosely striated* and *ribbed*, distinctly *gaping posteriorly;* hinge in the right valve with two cardinal teeth, and a third very small, but usually obsolete, anterior; the middle one is prominent, curved as in Petricola; the posterior is longitudinally lamellar, low and bifurcate; in the left valve are three distant and very unequal cardinal teeth; the middle one is similarly projecting as the corresponding tooth in the other valve. *Rup. lamellifera*, Conrad; may be considered as a type of a group. *Dist.*—Europe, Pacific, etc.

(lxxxiii.) Family CARDIIDÆ.

Genus CARDIUM. (648-651.)

Shell *ventricose*, close or gaping posteriorly; umbones *prominent*, sub-central; *radiately ribbed;* margins *crenulated;* pallial line more or less sinuated. *Dist.*—World-wide; from sea shore to 140 fathoms. Gregarious on sands and sandy mud.

(lxxxiv.) Family CHAMIDÆ.

Genus CHAMA. (652.)

Shell attached *usually by the left umbo; valve foliaceous*, the *upper smallest;* hinge tooth of free valve thick, curved, received between two teeth in the other; adductor impressions large, oblong, the anterior encroaching on the hinge-tooth. *Dist.*—Tropical seas, especially amongst coal reefs: fifty fathoms. West Indies, Canaries, Mediterranean, India, China, Australasia.

(lxxxv.) Family LUCINIDÆ.

Shell *orbicular*, free, closed; hinge-teeth 1 or 2; laterals 1—1; or obsolete; interior dull, *obliquely furrowed;* pallial line simple; muscular impressions two, *elongated, rugose*, ligament external or sub-internal.

Genus LUCINA. Brug. (653-655.)

Shell *orbicular, white*, sometimes divaricately striate; umbones depressed; lunule distinct; margins smooth or minutely crenulated; ligament oblique, *semi-internal;* hinge-teeth 2—2, latterals 1—1 and 2—2 or obsolete; muscular impressions rugose, anterior elongated within the pallial line, posterior oblong; umbonal area with an oblique furrow. *Dist.*—Universal.

Sub-Genus. CYCLAS. Klein.

Valves divaricately striate.

Genus LORIPES. Poli. (656.)

Shell almost equilateral, *cancellated or sculptured by flexuous striæ;* lunule short, cartilage *quite internal;* teeth one cardinal in the right and two in the left valve; laterals remote, and sometimes indistinct. *Dist.*—Atlantic, Mediterranean, W. Indies, Australasia.

(lxxxvi.) Family UNGULINIDÆ.

Genus MYSIA. (657.)

Shell *sub-orbicular smooth;* ligament *double*, rather long, sub-marginal; hinge-teeth 2·2, of which the anterior in the left valve, and posterior in the right are bifid; muscular impressions polished, anterior elongated. *Dist.*—West Indies, Rio, Britain, Mediterranean, Red Sea, West Africa, India, Corea, Australia, California.

(lxxxvii.) Family ERYCINIDÆ.

Shell *very small, thin, fragile, usually transparent*, and sometimes gaping, rounded or transverse, laterally depressed; hinge narrow, with one or two cardinal teeth, the lateral more or less elongated, compressed sometimes wanting; muscular impressions small, not well-marked; pallial line *simple.*

Genus LASÆA. (658-659.)

Shell minute and *roundish, oval;* beak straight; cartilage long, placed at the *shorter end of the shell*, contrary to that in *Kellia;* left valve with a minute thorn-like cardinal tooth; and in each valve two remarkably strong lateral teeth. *Dist.*—Universal.

Genus KELLIA. (660-661.)

Shell small, thin, sub-orbicular, closed, *beaks small;* margins smooth; ligament internal, interrupting the margin, or on the thickened margins; cardinal teeth 1 or 2, laterals 1—1 in each valve. *Dist.*—Norway, New Zealand, California.

(lxxxviii.) Family CRASSATELLIDÆ.

Genus CRASSATELLA. (662-664.)

Shell *solid, ventricose*, attenuated behind, smooth or concentrically furrowed; lunule distinct; *ligament internal;*

margin smooth or denticulated; pallial line simple; hinge-teeth 1·2, striated in front of cartilage-pit; lateral teeth 0—1, 1—0; adductor impressions deep, rounded; pedal small, distinct. *Dist.*—Australia, New Zealand, Philippines, India, West Africa, Canaries, Brazil.

(lxxxix.) Family ASTARTIDÆ.

Shell *thick, solid, equivalve,* the cardinal teeth always well developed, 2—3 in each valve; lateral teeth sometimes present on one or both sides, ligament always external, strong; muscular scars ovate, the anterior usually with a small deep superimposed pit, produced by the retractile muscles of the foot; pallial line entire.

Genus CARDITA. (665-668.)

Shell oblong, *radiately ribbed;* ligament external; *margins toothed;* hinge-teeth 1·2, and an elongated posterior tooth; *pallial line simple ;* anterior pedal scar close to adductor. *Dist.*—Universal.

Genus MYTILICARDIA. (669-670.)

Shell *elongated, very inequilateral,* with *squamous radiating ribs ;* hinge with an anterior triangular cardinal tooth; posterior cardinal tooth double in the left valve; no anterior laterals. Foot rounded, grooved, byssiferous. *Dist.*—Universal.

(xc.) Family UNIONIDÆ.

Genus UNIO. (671.)

Shell *nacreous; epidermis thick and dark, oval or elongated, smooth,* corrugated, or spiny, becoming very solid with age; anterior teeth 1·2, or 2·2, short, irregular; posteror teeth, 1·2, elongated, laminar. *Dist.—Fresh water.* Universal.

(xci.) Family TRIGONIIDÆ.

Genus TRIGONIA. (672.)

Shell *trigonal, nacreous internally,* thick, *tuberculated* or ornamented with *radiating or concentric* ribs; posterior side angular ; ligament small and prominent; hinge-teeth 2·3, *diverging, transversely striated; centre tooth of left valve divided*; pedal impressions in front of the posterior adductor, and one in the umbo of the left valve; anterior adductor impression close to the umbo; pallial line simple. *Dist.*—Australia.

(xcii.) Family NUCULIDÆ.

Shell oval, or *trigonal*, *small*, *nacreous within*; hinge composed of a *great number of transverse teeth*, interrupted by a *central pit* for the reception of the ligament, which is internal or external.

Genus NUCULA. (673-674.)

Shell *trigonal*, with the umbones turned towards the short posterior side, smooth or sculptured; *epidermis olive*, *interior pearly*; margins *crenulated*; hinge *with prominent internal cartilage pit*, and a series of sharp teeth on each side; *pallial line simple*. *Dist.*—Northern and Arctic Seas; 10—180 fathoms; Siberia, Melville Island, New England, Britain, Mediterranean, Cape, Japan, Australia.

Genus LEDA. (675-676.)

Shell resembling Nucula; oblong, rounded in front, produced and pointed behind; margins even; *pallial line with a small sinus*; umbonal area with a linear impression joining the anterior adductor. *Dist.*—Northern and Arctic Seas; 10—180 fathoms; Siberia, Melville Island, New England, Britain, Mediterranean, Cape, Japan, Australia.

(xciii.) Family ARCIDÆ.

Shell regular, equivalve, with *strong epidermis*; ligament exterior, occupying an area between the beaks; *hinge with a long row of similar comb-like teeth*; pallial line distinct; muscular impressions sub-equal; structure corrugated, with vertical tubuli in rays between the ribs of striæ.

Genus ARCA. (677-681.)

Shell equivalve, or nearly so, thick, *sub-quadrate*, ventricose, strongly ribbed or cancellated; margins smooth or dentated, close or sinuated ventrally; hinge straight, teeth very numerous transverse; umbones anterior, separated by a flat, lozenge-shaped ligamental area, with numerous cartilage grooves; pallial line simple; posterior adductor impression double; pedal scars two, the posterior elongated. *Dist.*—World-wide, most abundant in warm seas; low-water, 230 fathoms.

Genus PECTUNCULUS. (682-685.)

Shell *orbicular*, nearly equilateral, smooth or radiately striated; umbones central, divided by a striated ligamental area; hinge with a semi-circular row of transverse teeth; adductor sub-equal; pallial line simple;

margins crenated inside. *Dist.* — West Indies, Britain, India, New Zealand, West America; ranging from 8 to 60, rarely 120 fathoms.

Genus Limopsis. (685.)

Shell orbicular, convex, *slightly oblique,* ligamental area with a *triangular cartilage pit* in the centre; hinge with two equal curved series of transverse teeth. *Dist.*—Red Sea (Nyst.), Japan, Britain, Tasmania. Mr. M'Andrew has dredged L. *Pygmæa* living on the coast of Finmark.

(xciv.) Family Mytilidæ.

Shell equivalve, *oval or elongated,* closed, umbones anterior, *epidermis thick and dark,* often filamentose; *ligament internal,* sub-marginal, very long; *hinge edentulous*; outer shell-layer obscurely prismatic-cellular; *inner more or less nacreous*; pallial line simple; anterior muscular impression small and narrow; posterior large, obscure.

Genus Mytilus. (686-691.)

Shell *wedge-shaped,* rounded behind, smooth in the typical species; umbones terminal, pointed; hinge-teeth minute or obsolete; pedal muscular impressions *two in each valve,* small, simple, close to the adductors. *Dist*—World-wide, Ochotsk, Behring's Sea, Russian Ice-meer, Black Sea, Cape Horn, Australasia.

Genus Modiola. (692-694.)

Shell *oblong, inflated in front*; umbones anterior, obtuse; hinge toothless; pedal impressions *three in each valve,* the central elongated; epidermis often produced into long beard-like fringes. *Dist.*—Universal.

Genus Modiolaria. (695.)

Shell rhomboidal, sculptured by two rows of striæ (one on each side), which radiate from the beaks, leaving the middle portion smooth; umbones incurved; hinge edentulous or crenulated, hinge-plate finely notched. *Dist.*—Temperate and Arctic Seas.

(xcv.) Family Aviculidæ.

Shell *inequivalve, very oblique,* resting on the smaller (right) valve, and attached by a byssus; epidermis indistinct; outer layer prismatic-cellular, *interior nacreous*; posterior muscular impression large, sub-central, anterior small within the umbo; pallial line irregularly dotted; hinge-line straight, elongated; umbones anterior, eared, the posterior ear wing-like; cartilage contained in one or several grooves; *hinge edentulous or obscurely toothed.*

Genus AVICULA. (696-697.)

Shell *obliquely oval, often thin diaphanous,* very inequivalve, *eared,* the *posterior ear produced wing-like*; right valve with a byssal sinus beneath the anterior ear; cartilage pit single, oblique; hinge with one or two small cardinal teeth, and an elongated posterior tooth, often obsolete; posterior muscular impressions (adductor and pedal) large, sub-central; anterior (pedal scar) small, umbonal. *Dist.*—Mexico, South Britain, Mediterranean, India, Pacific, Australasia; 20 fathoms.

Genus CRENATULA. (698.)

Shell *thin, oblong compressed,* byssal sinus obsolete; cartilage pit shallow, crescent-shaped. *Dist.*—N. Africa, Red Sea, China, in sponges.

Genus VULSELLA. (699.)

Shell *oblong, striated,* sub-equivalve, *with an inner pearly and outer fibrous layer;* umbones straight, earless. Often found imbedded in living sponges. *Dist.*—Red Sea, India, Australia, Tasmania.

(xcvi.) Family PINNIDÆ.

Genus PINNA. (700.)

Shell equivalve, *wedge-shaped;* umbones quite anterior; posterior side truncated and gaping; ligamental groove linear, elongated; hinge edentulous; anterior adductor scar apical, posterior sub-central, large, ill-defined pedal scar in front of posterior adductor. *Dist.*—U. S., Britain, Mediterranean, New Zealand, Tasmania, Australia, Pacific, Panama.

(xcvii.) Family SPONDYLIDÆ.

Genus SPONDYLUS. (701.)

Shell *irregular,* attached by the right valve, *radiately ribbed, spiny or foliaceous;* umbones remote, eared; ower valve with a triangular hinge-area, cartilage lin a central groove, nearly or quite covered; hinge of two curved interlocking teeth in each valve; adductor impression, double. *Dist.*—West Indies, Canaries, Mediterranean, India, Australasia, Torres Straits, Pacific, W. America, 105 fathoms.

(xcviii.) Family PECTINIDÆ.

Genus PECTEN. (702-706.)

Shell *sub-orbicular*, regular, resting on the right valves, usually ornamented with *radiating ribs;* beaks approximate, *eared;* anterior ears most prominent; posterior side a little oblique; right valve most convex, with a notch below the front ear; hinge margins straight, united by a narrow ligament; cartilage internal, in a central pit; adductor impressions double, obscure; *pedal impression only in the left valve, or obsolete. Dist.*—World-wide, Nova-Zembla, Cape Horn; 200 fathoms.

(xcix.) Family LIMIDÆ.

Shell *eared*, white, gaping at the sides; hinge edentulous, with a *central, trianqular cartilage-pit.*

Genus LIMA. (707-708.)

Shell equivalve, compressed, *obliquely oval;* anterior side straight, gaping, posterior rounded, usually close; umbones apart, eared; valves white, smooth, punctate, striate, or radiately ribbed and imbricated; there is usually a thin, brownish epidermis; hinge-area triangular, cartilage-pit central; adductor impression lateral, large, double; pedal scars two, small. *Dist.*—Norway, Britain, West Indies, Canaries, India, Australia, 1-150 fathoms. The largest living species (*L. excavata*, Chemn) is found on the Coast of Norway.

(c.) Family ANOMIIDÆ.

Genus PLACUNANOMIA. (709.)

Shell adherent, sub-equivalve, *irregular, flattened;* hinge with two thick divergent elongated lamella in the inferior, corresponding with two long pit in the upper valve; upper valve with only two muscular impressions, the pedal scar radiately striated; the byssal plug is often fixed in the lower valve, and its muscle becomes (functionally) an adductor. *Dist.*—West Indies, Britain, New Zealand, California, Behring's Sea, Ochotsk; 50 fathoms. Mocine, California. *P. macrochissna*, Desh.

(ci.) Family OSTREIDÆ.

Genus OSTREA. (701-713.)

Shell *irregular*, attached by the left valve; upper valve *flat or concave*, often plain; lower *convex*, often plaited or foliaceous, and with a prominent beak; ligamental cavity triangular or elongated; hinge toothless; structure *sub-nacreous*, laminated with prismatic-cellular substance between the margins of the laminæ. *Dist.*—Tropical and temperate seas, Norway, Black Sea, Australasia, etc.

BRACHIOPODA.

(cii.) Family TEREBRATULIDÆ.

Shell *minutely punctate;* usually round or oval, smooth or striated; ventral valve *with a prominent beak, perforated near or at the apex,* and attached by a portion of the valve itself; hinge with two curved teeth; dorsal valve with a depressed umbo, a prominent cardinal process between the dental sockets, and a *slender shelly loop.* (*Lamp shell.*)

Genus WALDHEIMIA. (714.)

Shell *smooth or plaited,* dorsal valve frequently impressed; *foramen complete;* loop elongated or reflected; septum of smaller valve elongated. *Dist.*—Norway, West Indies, Java, Australia, California, Cape Horn; low water, 100 fathoms.

Genus KRAUSSIA. (715-716.)

Shell small, *transversely oblong;* hinge-line nearly straight; beak truncated, laterally keeled; area flat; *foramen large, deltidum rudimentary;* dorsal valve longitudinally impressed, furnished inside with a forked process, rising nearly centrally from the septum; interior often strongly tuberculated. The Apophyses are sometimes a little branched. *Dist.*—S. Africa, Sydney, New Zealand; low-water to 120 fathoms. K. *rubra,* Pallas.

DESCRIPTIVE TERMS.

EXPLANATION OF TERMS COMMONLY USED IN DESCRIBING THE EXTERNAL CHARACTERS AND FORMS OF VARIOUS KINDS OF SHELLS.

Shells are said to be *external* when the animal is contained in them, and *internal* when they are concealed in the mantle; the latter, with many species devoid of shelly covering, are termed *naked* mollusca. The greater number of shells have but one shell (usually a closely-set spiral tube or cone,) and are termed *univalves*; the others are mostly composed of two valves (*bivalve*) hinged together, generally under the *beak or* *umbo.* Some bivalves, as in Pholas and Barnea, have one or two accessory plates near the hinge, while the Chitons have eight imbricating valves like an articulated limpet, and are termed *multivalves.* The conical or flatly conical shells of the limpet group are usually *simple* and not *spiral.* The following are a list of terms applied to the principal distinguishing character of shells generally.

UNIVALVES.

FORM OF SHELL.

	*Example fig. No.
I. (*a*) Regularly spiral.	
1. Elongated, subulate, elevated	32
2. Turreted, turriculate, an elongated shell with the whorls angulate or shouldered on their upper part	33
3. Cylindrical, pupiform	44, 45
4. Short, bucciniform	5
5. Fusiform, spindle-shaped	2, 3
6. Contabulate, short, with shouldered whorls	—
7. Globular, rounded	16
8. Depressed, lenticular	19
9. Discoidal, having the form of a disc or quoit	21, 22
10. Convolute, aperture about as long as the shell, nearly or quite concealing the spire	24, 25, 26, 28
11. Trochiform, pyramidal, conical, with a flat base	11
12. Turbinated, conical, with rounded base	9, 18
13. Cone shaped, obconic	27
14. Few whorled, whorls rapidly increasing	13, 36
15. Many whorled, whorls slowly or gradually increasing	12, 39
16. Ear-shaped	23
17. Subulate, awl-shaped	38
18. Acicular	40
(*b.*) Irregularly spiral, evolute	31
(*c.*) Tubular, tusk-like, tooth-like	46
(*d.*) Boat-shaped, slipper-shaped...	14, 15
(*e.*) Conical or limpet-shaped	57, 58, 59
(*f.*) Multivalve and imbricated	47

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* See accompanying Plate.

DIVISIONS OF THE SHELL.

		Example fig. No.
II.	Apex, the posterior end of shell, or *nucleus*	5^a
	1. The *nucleus* may be *reversed* or *sinistral*, turning to the left as in the body whorls of Physa	
	2. Dextral, turning to the right, normal condition	
	3. Oblique, when the nuclear whorls are set at an angle, unconformable with the body whorls	
III.	Whorl, a single complete revolution of the spiral cone	11^a
	1. Periphery, that part marking its greatest circumference	8^a 21^a
	2. Suture, the line of channel formed by the junction of the whorls	5^c
	3. Body-whorl usually capacious, the last turn ending with the aperture	36^a
IV.	Base, anterior extremity opposite end to apex, usually the front of the aperture	11^a
	1. Oblique, as in	20
	2. Concave, as in	20
	3. Convex, as in	19
	4. Flat, as in	11-12
V.	Aperture, the open mouth of the shell, the interior of which may be simple or entire, or may be channeled by a gutter or canal, more or less produced or everted (2.3). The aperture is:—	
	1. Longitudinal, when its greatest diameter is parallel to the axis of whorls	27
	2. Transverse, reverse of longitudinal	13
	3. Oblique, greatest diameter oblique to the axis	37
	4. Rounded, the circle slightly interrupted	9
	5. Auriform, ear-shaped	35
	6. Ovate, egg-shaped	36
	7. Oblong, rounded above and below, longer than wide	17
	8. Lunate, semi-lunar, semi-circular	16
	9. Triangular	

	Example fig. No.
10. Linear, narrow	26
11. Quadrate, squarish	13
12. Patulous, dilated at its entrance	
13. Compressed, diminished at its entrance	
14. Produced, lengthened out	2^d 3^c
15. Sometimes truncated, stunted, cut short abruptly at the end	5, 6, 33-34
VI. Peristome. Sometimes peritreme. Margin of aperture. It is:—	
1. Continuous or entire, as in	8, 9, 21, 44
2. Interrupted, when the left side of aperture is formed only by the body-whorl	5
3. The left side is formed either by the *inner* or *columella lip* (labrum) or partly by the body-whorl or *parietal wall.* The right side is formed by the *outer lip* (*labrum.*)	
VII. Outer lip may be:—	
1. Thin and sharp	7
2. Thickened	1
3. Reflected, curled outwards	8
4. Inflected, curled inwards	25
5. Expanded, swollen	1
6. Digitate.	
7. Foliated, fringed with spines.	
8. Emarginate, incised, or slit	8^a
9. Effuse, when basal or anterior extremity is slightly produced, depressed, or reflected	32, 33, 34
10. Sinuous, bent or curved interiorly. It may be:—	
11. Dentate, toothed	3, 29
12. Plicate or lamellate, when the teeth become rib-like.	
13. Ringent, having *large* plications, nodules or teeth.	
14. Deflected, deflexed, bent aside or backwards.	

VIII. Inner lip or columella margin may have characters like those described under outer lip.

IX. Umbilicate. Perforate. When the base of the axis or columella, around which the whorls are coiled, is open or hollow (12^a.) It is ***sub-umbilicated***, or ***sub-perforate*** when partly covered over by shelly matter (16). It is not umbilicated or non-perforate, where the axis of the shell is solid.

SCULPTURE OR COLOUR MARKINGS.

X. These are:—

	Example fig. No.
1. Longitudinal, when taking the direction of the axis.	
2. Revolving or transverse, when they follow the spiral.	
3. Canaliculate. Suture deeply channeled	5
4. Cingulate. Encircled by revolving ribs	9
5. Carinate, revolving sculpture prominent, sharp	9
6. Sulcate, encircled by channels	10, 11
7. Plicate, costate, ribbed. Sculpture longitudinal	4, 5, 8
8. Nodosely, tuberculately, granosely plicate, when the ribs are broken up into tubercles or granules; mostly caused by the intersection of revolving sculpture	9
9. Striate, covered by fine close lines, either longitudinal or revolving.	
10. Punctate, pitted. Frequently punctate, striate, *i.e.*, 9 & 10 combined	11
11. Granulate, nodose, tuberculate, covered with nodules of small or large size, but ***not ribbed***	3
12. Muricate, spinous, echinate when the nodules are ***sharp pointed.***	
13. Decussate, cancellate, longitudinal and revolving sculpture, crossing at ***right angles.***	
14. Reticulate, sculpture not crossing at right angles, irregularly decussate.	
15. Clathrate, longitudinal and revolving lines both distant, forming a pattern somewhat like the iron bars of a prison window.	

16. Coronate, the upper part of the whorls having a series of revolving tubercles or spines ... ... —
17. Varicose, when the external thickening of the outer lip of aperture occuring in some shells during rest-periods is not absorbed when growth is resumed, but remains crossing the whorls, rib-like, at regular intervals ... ...

XI. Operculum. A horny or shelly lid which closes the aperture of a large number of univalve shells. It is .—

1. Concentric when nucleus is central or sub-central.
2. Imbricated or lamellar when nucleus is marginal.
3. Claw-shaped or unguiculate, nucleus apical or in front.
4. Spiral, revolving gradually and growing on one edge.
5. Pauci-spiral, few rapidly increasing whorls.
6. Sub-spiral, scarcely spiral.
7. Multi-spiral, many whorled.
8. Articulated when it has a projection.
9. Radiated, modification of the articulated form in which the spiral is not so evident.

BIVALVES.

XII.

Arcuated, bent in the form of an arch.
Auriform, ear-shaped.
Auricled, having appendages like ears. ...
Byssus, a beard.
Gibbous, bulging, swollen.
Compressed, squeezed together.
Concamerated, arched over, vaulted.
Concave, hollowed out ... ...
Concentrically rayed or ribbed, curved, with the umboe as a centre.
Cordate, cordiform, heart-shaped.
Crenulated, notched at the margin, scalloped ... ...

Example fig. No.

Cuneiform, wedge-shaped ... ... (55)

Cylindrical, round, like a roller or cylinder.

Cymbiform, boat-shaped.

Denticulated, set with small teeth as in Arca.

Dexter valve, right valve.

Divaricated, spreading out widely.

Dorsal margin, the side on which the hinge is placed.

Elliptical, having the form of an ellipse.

Elongated, lengthened, drawn out.

Gap, gaping; when the valves are shut in some bivalves, as in Pholas, an opening is disclosed called the gap.

Globose, globular.

Hemispherical, in the shape of a half-globe.

Inequilateral, when the anterior and posterior sides make different angles with the hinge. *Equilateral*, having both sides alike.

Inequivalve when one valve is more convex than the other, or dissimilar in other respects, as in the common oyster.

Equivalve, having both valves alike.

Lenticulate, doubly convex, of the form of a lens.

Ligament, a solid body, softer than a cartilage, but harder than a membrane, which connects the valves. *External ligament* usually attached to ridges on the posterior, hinge-margin behind the umbones.
In some bivalves, as in Mactra, the ligament is internal, lodged in a cartilage furrow, or pit.

Limb, the margin in bivalve shells.

Lobated, rounded at the edge.

Lunule, a crescent-like mark or spot, situated near the anterior and posterior slopes.

Nacred, nacreous, pearly.

Oblong-ovate, egg-shaped or oval.

Obsolete, indistinct, not well defined

Papyraceous, thin as paper.

Exam
N

Pectinated, resembling the teeth of a comb.
Pinnated, winged.
Quadrangular, having four right angles.
Radiately, rayed or ribbed, rays or ribs springing from umboe, in the direction of limb or margins ...
Ridge, the upper part of a slope.
Scalloped, indented at the edges.
Serrated, having teeth like a saw.
Serrulated, very minutely serrated.
Sub-arcuated, somewhat arched.
Sub-diaphanous, somewhat transparent.
Transverse, breadth greater than length.
Trapeziform, shaped like a trapezium.
Trigonal, having three angles, deltoid.
Turgid, swollen.
Ventral margin, the margin opposite the hinge-margin.
Ventricose, inflated or swelled in the middle.
Umbo, the beak or round part which turns over the hinge.

NOTE.—Many of the terms relating to the sculptur univalves, are also applicable to the sculpture of bivalves.

LENGTH, BREADTH AND THICKNESS.

The hinge line of bivalves indicates the direction of the *length* of the shell, and the actual length is the maximum distance between lateral margins.

The breadth is the greatest diameter measured transversely to length.

The thickness is the greatest diameter of an imaginary line passing through one or both valves.

LIGAMENT.

The *valves* of the Pelecypods are bound together by a *ligament*, (49c) and usually articulated by a *hinge* furnished with interlocking teeth. The shell is closed by (either one or two) powerful *adductor muscles* (53a) but opens spontaneously by the action of the *ligament* when the animal relaxes, and after it is dead.

Example fig. No.

UMBO.

The *apex, beak or umbo* (49^d) is the point from which the growth commences and is situated near the hinge. The beaks are either straight, as in Pecten, curved as in Venus or Cardium, or spiral, as in Isocardia.

RIGHT AND LEFT VALVE.

When a shell is placed so that the dorsal margin is furthest from the observer, with the exterior side of valve uppermost, the position of the ligament to the right indicates the left valve, if to the left the right valve.

The *lunule* is a small cordate or semicircular impression under and anterior to the beaks. When this appears to the right the valve is right, and *vice-versa.*

The *sinus* or *flexure* (fig. 49^e) of the pallial impression (48^c) when present is seen under the ligament. When the inside surface is viewed with the dorsal margin furthest from observer, if to the right it indicates the right valve, and *vice-versa.* Sometimes there are posterior lateral teeth, or laminæ of the hinge-margin, and are found on the right or left side accordingly as the valve is right or left. Thus the *pallial sinus*, the *external ligament*, (49^c) and the *posterior slope* (49^a) are to the right side, (the internal surface being exposed with the beak furthest from observer,) in the *right valve* (49), and *vice-versa.*

Linnæus and the older naturalists were wont to describe the front of the shell as the back and the right valve as the left.

Hinge-line and Teeth.

The dorsal margin on which the ligament and teeth are situated is termed the *hinge-line*. It is long and straight in Arca, short in Vulsella, and curved in most genera.

The central teeth immediately under umbo are called *hinge* or *cardinal* teeth (48^{a}), those on each side are *lateral* teeth (48^{b}), either the *cardinal* or the *lateral* teeth may be lacking in many shells, while in some teeth are entirely absent.

Edentulous.

The dentition formulæ are usually stated as follows :—Cardinal teeth 2·3 or $\frac{2}{3}$—meaning 2 in the *right* valve, 3 in the left; lateral teeth, 1—1, 2—2, or 1 anterior and 1 posterior in *right* valve, 2 anterior, and 2 posterior lateral teeth in the *left* valve.

Adductor or Muscular Impressions. (49$^{\text{f.g.}}$)

The greater number of bivalves have two *adductor muscles*, whose *impressions or scars* on the shell, nearly equal in size, are situated respectively on the anterior and posterior sides at the extremities of the hinge-line. In Mytilus, Modiola, these two *adductor impressions* are unequal, the posterior one being very much larger. In the Pectens, Oysters and Limas, there is only *one* strong *adductor impression* (53^{a}), placed more centrally. The single *muscular scar is* not quite central, but nearer the posterior than the anterior side.

Epidermis. Scarf or Skin.

All bivalve shells are clothed with an *epidermis*, *scarf*, or *skin*. Inconspicuous in some, but remarkably developed in others.

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2	*Chemnitz*—Conchylien Cabinet, 12 vols	1769-95
3	*Martyn*—Universal Conchologist, 4 vols.	1784
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5	*Quoy and Gaimard*—Voyage of the Astrolabe. Zoology ...	1830
6	*Gray, J. E.*—Yates, New Zealand	1838
7	——— —Diffenbach's, New Zealand	1843
8	*Reeve, L.*—Conchologica Iconica, 20 vols.	1843-78
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9	Gould—Expedition Shells. 8vo. Boston	1846
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11	*Pfeiffer, Dr. L.*—Descriptions of 36 new species of Helix. Tas. Journal. P. 404	1849
12	*Deshayes*—Proceedings of the Zoological Society ...	1853
13	*Hombron and Jacquint*—Voyage au Pole Star	1853
14	*Adams, A.*—Proceedings of the Zoological Society ...	1851-6
15	——— —Monograph of recent species. Trigonia. Proc. Roy. Soc. Tas. P. 199	1854
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24	Smith—Voyage of the Erebus and Terror ; Mollusca ...	1874
25	*Tenison - Woods*—Description of New Tasmanian Marine Shells (1st series)	*1875
26	————Description of New Tasmanian Marine Shells (2nd series)	*1876
27	————*Census* of New Tasmanian Marine Shells	*1877
28	————Fresh water Shells of Tasmania ...	*1875
29	————On some Marine Shells (recent additions not embraced in Census)	*1877
30	————Observations on *Patellidæ and Nudibranchiata*, and Ampullaria (?) Amnicola...	*1876
31	————On some new Marine Shells (not embraced in Census.) (Roy. Soc. Vic.)	1877-8
32	————On some Tasmanian Trochidæ ...	*1879
33	*Johnston, R. M.*—Further notes on Tasmanian Fresh Water Shells, with descriptions of seven new species	*1877
34	————Notes on the distribution and variability of Tasmanian Land Shells	*1878-9

Index No.		Year of *Publication.*
35	*Johnston, R. M.*—Table showing the general distribution of Tasmanian Land Shells	*1879
36	*Tenison - Woods*—On some Tasmanian Fresh Water Shells	*1878
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40	*Petterd, W.*—A Monograph of the Land Shells of Tasmania, describing 79 species	1878-9
41	*Tenison-Woods*—Notes on *Bithynella*, etc. (Proc. Roy. Soc. Tas.)	1879
42	*Tate, Prof. Ralph*—On some Australian Slugs. (Proc. Roy. Soc. Tas.)	1880
43	Beddome, Lieut. C.E.—Description of two new Marine Shells. (Proc. Roy. Soc. Tas.)	1881
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47	*Hutton, Prof., F. W.*—Notes on New Zealand *Hydrobiinæ*, *Pulmonate* Mollusca, etc. (Trans. N. Z. Institute) ...	1881
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54	*Tate, Prof. Ralph*—On the Australian Pectens, confounded with the New Zealand *P. laticostatus*. Gray. (Proc. Roy. Soc. Tas.)	1886
55	*Brazier, John*—The Trochidæ and other Genera of Mollusca from Tasmania, with their synonyms. (Proc. Roy. Soc. Tas.)	1886
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57	*Petterd, W. F.*—Contributions for a Systematic Catalogue of the Acquatic Shells of Tasmania. (Proc. Roy. Soc. Tas.)	1888
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CLASSIFIED LIST OF SPECIES.

(The numbers to the extreme right refer to index number of the publications containing fuller particulars or descriptions recorded in the Bibliography pages 71, 72.)

CLASS CEPHALOPODA.

(i.) Family OCTOPIDÆ. (sp. 2.)

1	Octopus maorum. *Hutton*	27, 46
2	Pinnoctopus cordiformis. *Quoy*	46

(ii.) Family ARGONAUTIDÆ. (sp. 1.)

3*	Argonauta tuberculata. *Shaw*	27, 46

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(v.) Family SPIRULIDÆ. (sp. 1.)

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13 Typhis arcuatus. *Hind's Voyage of Sul* ...
14 Trophon umbilicatus. *T.-Woods* ...
15 ——— squamosissima. " ...
16 ——— Petterdi. *Crosse* ... ...
17 ——— Brazieri. *T.-Woods* ...
18 ——— Assisi. " ...
19 ——— Mariæ. " ...
20 ——— Hanleyi. " ...
21 ——— Goldsteini. " ...
22 ——— Australis. " ...
23 Purpura textilosa. *Lam.* ... ...
24 ——— humilis. *Crosse* ... ...
25 ——— succincta. *Martyn* ...
26 ——— madreporarum. *Sow.* ...
27 ——— (?) littorinoides. T.-Woods ...
28 ——— propinqua. T.-Woods ...

(viii.) Family TRITONIDÆ. (

29 Triton cutaceus. *Linne* ... ...
30 ——— *Spengleri.* *Dillwyn.* (Regarded by
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31 ——— *Waterhousei.* *Ad. and Angas.* May
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32 ——— Quoyi. *Reeve*
33 ——— subdistortus. *Lam.* ... ...
34 Ranella leucostoma. Lam. ... ...
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45	——— *trapezium.* Linne. (Reeve considers this form a variety of F. coronata.)	27

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60	Eburna (Zemira), Australis. *Sow.*	27

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61	Nassa Fasciata. *Lam.*	27
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74	——— glabra. *Swainson*	27
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76	——— pica. *Reeve*	27

77	Mitra declivis. *Reeve.* May be a variety of M. glabra. (T.-Woods)	27
78	—— capensis. *Dunker.* (*M. Weldii.* T.-Woods)	27
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84	—— granatina. *Swainson and T.-Woods*	27
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136	——— (Clathurella) Philomenæ. *T.-Woods*	27
137	——— " granulosissima. "	31
138	——— " sculptilior "	31
139	——— (Daphnella) Tasmanica. *T.-Woods*	27
140	——— " varix. "	27
141	——— (Cythara) Tasmanica "	27
142	——— (Mangelia) St. Gallæ "	27
143	——— " Desalesii "	27
144	——— " Atkinsoni "	27
145	——— " Meredithæ "	27
146	——— " immaculata "	27
147	——— " Le-Tourneuxiana. *Crosse*	27
148	——— " Harrisoni. *T.-Woods*	31
149	——— " delicatula "	31
150	——— " alternata "	31
151	——— " trachys "	31
152	——— " cancellata. *Beddome*	49

(xx.) Family Conidæ. (sp. 5.)

153	Conus Novæ-Hollandiæ. *Adams*	27
154	——— pontificalis. *Lam.*	27
155	——— Tasmaniæ. *Sow.*	27
156	——— rutila. ( ) *C. Macleay and T.-Woods*	27
157	——— Carmeli. *T.-Woods*	27

(xxi.) Family Cypræidæ. (sp. 8.)

158	Cypræa *Annulus. Linne*	27
159	——— angustata. *Gray*	27
160	——— piperata. *Soland.*	27
161	——— Comptoni. *Gray*	27
162	——— (Cyprovula) umbilicata. *Sow.*	27
163	——— *Scotti ? Brod.*	27
164	——— (Trivia.) Australis. *Lam.*	27
165	Ovulum. (Volva.) Maccoyi. *T.-Woods.* (*Birostra.* T.-Woods)	27

(xxii.) Family Cassididæ. (sp. 5.)

166	Cassis. (Semi-cassis) semigranosa. *Lam.*	27
167	——— " tumida. *Petterd*	53
168	——— (Cassmaria) pyrum. *Lam.*	27
169	——— " *nivea. Brazier.* Regarded by T.-Woods as a variety of *C. pyrum*	27
170	——— (Cassmaria) Paucirugus. *Menke*	27

(xxiii.) Family Naticidæ. (sp. 9.)

171	Natica conica. *Lam.*	27
172	——— Beddomei. *R. M. Johnston.* (Proc. Roy. Soc. Tas., 1884. P. 221. *N. polita.* T. Woods.)	27
173	——— Tasmanica. *T.-Woods*	27
174	——— nana. "	27
175	——— Strangei. "	27
176	——— (Mamilla.) umbilicata. Quoy	27
177	——— " globosa. *T.-Woods.* Probably merely a white variety of *N. umbilicata*	27
178	Sigaretus zonalis. *Quoy*	27
179	Lamellaria. Sp. indet. North West Coast. (T. R. Atkinson.)	27

(xxiv.) Family Calyptræidæ. (sp. 8.)

180	Infundibulum calyptræformis. *Lam.* (*Trochita,* T.-Woods)	27
181	Legrandia Tasmanica. *Beddome*	48
182	Calyptræa Harrisoni. *Beddome.* (*Cemoria, Beddome*)	48
183	*Crepidula* (*sp ?*). Waterhouse Island	27
184	——— (*sp ?*) Frederick Henry Bay	27

185	*Hipponyx* foliacea. Quoy. (*Cochlolepas*, T.-Woods)	27
186	——— subrufa. Sow. (*Cochlolepas*, T.-Woods	27
187	——— (Amalthea) Conica. *Schum.*	27

(xxv.) Family SOLARIIDÆ. (sp. 3.)

188	Solarium, luteum. Lam.	27
189	———. Sp. indet, Recherche	27
190	Adeorbis picta. T.-Woods	27

(xxvi.) Family SCALARIDÆ. (sp. 12.)

191	Scalaria Australis. *Lam.*	27
192	——— (Cirostrema) varicosa. *Lam.*	27
193	——— granulosa. *Quoy*	27
194	——— aculeata. *Sow.*	27
195	——— *delicatula. Crosse.*	27
196	——— *Jukesiana. Forbes*	27
197	——— lineolata. *Sow.*	27
198	——— *Philippinarum ? Sow*	27
199	———	
200	——— (Crossea) labiata. *T.-Woods*	27
201	——— (") concinna. *Angas, B.*	49
202	——— (") cancellata. *T.-Woods.* (*Delphinula Johnstoni.* Beddome)	49

(xxvii.) Family IANTHINIDÆ. (sp. 3.)

203*	Ianthina communis. *Lam.*	27
204*	——— *exigua. Lam.*	27
205	——— bipartita. *Gray ?*	27

(xxviii.) Family TURRITELLIDÆ. (sp. 5.)

206	Turritella Tasmanica. *Reeve*	27
207	——— granulifera. *T.-Woods*	27
208	——— Tasmaniensis. "	27
209	——— acuta. "	27
210	——— sinuata. *Reeve*	27

(xxix.) Family VERMETIDÆ. (sp. 3.)

211	Vermetus dentiferous. *Lam.*	27
212	Siliquaria Australis. *Quoy.* (*Tenagodus*, T.-Woods)	27
213	——— Weldii. *T.-Woods.* (" ")	27

(xxx.) Family EULIMIDÆ. (sp. 8.)

214	Eulima Tasmanica. T.-Woods	27
215	——— micans. "	27
216	——— proxima. *Sow.*	27

217	Eulima marginata. *T.-Woods*	31
218	——— apheles. "	31
219	——— Legrandi. *Beddome*	49
220	——— Petterdi. "	49
221	Stylifer Tasmanica. *T.-Woods*	27

(xxxi.) Family TURBONILLIDÆ. (sp. 12.)

222	Turbonilla *Angasi.* *Angas and T.-Woods*	27
223	——— Mariæ. *T.-Woods*	27
224	——— Macleayana. "	27
225	——— Tasmanica. "	27
226	Aclis tristriata "	27
227	Odostomia Tasmanica "	27
228	——— (Parthenia) Tasmanica. *T.-Woods*	27
229	——— lactea. *Angas*	27
230	——— bifasciata. *T.-Woods*	27
231	Syrnola Michæli. "	27
232	——— bifasciata "	27
233	Eulimella (Styloptygma.) Tasmanica. *T.-Woods*	27

(xxxii.) Family LITTORINIDÆ. (sp. 11.)

234	Littorina unifasciata. *Gray*	27
235	——— paludinella. *Reeve*	27
236	——— Hisseyana. *T.-Woods*	27
237	——— *undulata ?* *Gray.* Probably a variety of *L. unifasciata*	27
238	——— *Philippi ?* *Carpenter*	27
239	Risella nana. *Lam.*	27
240	——— melanostoma. *Gmelin*	27
241	——— *aurata ?* H. and A. Adams. Regarded by T.-Woods as a variety of *R. melanostoma*	27
242	Fossarus (Fossarina.) Petterdi. *Crosse*	27
243	——— Tasmanicus. *T.-Woods*	27
244	——— bulimoides. "	27

(xxxiii.) Family PLANAXIDÆ. (sp. 3.

245	Alaba (Diala) monile. *A. Adams.* (*D. tessellata.* T.-Woods	27
246	——— " lauta. " (*D. punctata.* T.-Woods	27
247	——— " tumida. T.-Woods	27

(xxxiv.) Family CERITHIIDÆ. (sp. 15.)

248	Cerithium dubium. *Sow.* Tate states that Sowerby's name has priority over *C. monachus.* C. and Fisch	27, 44
249	——— rhodostoma. *Adams*	27
250	——— serotina. *A. Adams*	27

251	Cerithium *Diemense. Quoy and Gaim.* (Tate, P. 31-32. Proc. Roy. Soc. Tas., 1881.)	27
252	——— (Bittium) granarium. *Kiener*	27
253	——— " turritella. *Quoy*	27
254	——— " Lawleyanum. *Crosse*	27
255	——— " minimum. *T.-Woods*	31
256	——— " turboniloides. "	31
257	——— " semi-lævis "	31
258	——— (Cerithiopsis.) Atkinsoni. " (Perhaps a variety of *C. crocea* Angas)	27
259	——— " albosutura. *T.-Woods*	27
260	Triforis fasciata. T.-Woods	31
261	——— Tasmanica. "	27
262	Potamides (Lampania) Australis. *Quoy*	27

(xxxv.) Family Rissoellidæ. (sp. 1.)

263. Tatea rufilabris. *A. Adams.* (*Tatea Huonensis.* T.-Woods. *Diala.* Adams.)

(xxxvi.) Family Rissoidæ. (sp. 48.)

264	Rissoina variegata. *Angas*	27
265	——— cincta. "	27
266	——— nivea. "	27
267	——— turricula. "	27
268	——— St. Claræ. *T.-Woods*	27
269	——— Flindersii. "	27
270	——— concatenata. "	27
271	——— Gertrudis "	27
272	——— Kershawi. "	31
273	——— supra-sculpta. "	31
274	——— uni-cirata. "	31
275	Rissoa Agnewi. "	27
276	——— cyclostoma. " var. *a rosea*	27
277	——— melanura. "	27
278	——— Angeli. " (Cyclostrema ?)	27
279	——— (Setia) Brazieri. "	27
280	——— " siennæ. *Assiminea Tasmanica.* T.-Woods	27
281	——— " Flamina. *Beddome*	49
282	——— (Cingula) Atkinsoni. *T.-Woods*	27
283	——— (Ceratia) Maccoyi. "	27
284	——— " puncto-striata. "	31
285	——— " Mariæ. "	27
286	——— (Alvania) cheilostoma. "	27
287	——— " fasciata. "	27
288	——— " Bayntoni "	49
289	——— minutissima. *T.-Woods*	27
290	Hydrobia *cristallina ? Pfr.* Petterd, Proc. Roy. Soc. Tas., 1888	57, 58

291	Hydrobia *Gunni ? Frauenfeld.* Tate and Brazier, Proc. Linn. Soc., N.S.W., 1881	57, 58
292	Hydrobia *Tasmanica ? Martins.* Petterd, Proc. Roy. Soc. Tas., 1888	57, 58
293	Hydrobia, turbinata. *Petterd*	57, 58
294	Bithynella (Potomapyrgus ?) nigra. *Quoy and Gaim*	57, 58
295	——— „ ? nitida. *R. M. Johnston.* (Fossil)	58
296	——— „ ? Dulvertonensis. T.-Woods	57, 58
297	——— „ ? Dunrobinensis. „	57, 58
298	——— „ ? Dyeriana. *Petterd*	57, 58
299	——— „ ? Simsoniana. *Brazier*	57, 58
300	——— „ ? Woodsii. *Petterd*	57, 58
301	——— „ ? Smithii. „	57, 58
302	——— „ ? Brownii. „	57, 58
303	——— „ ? marginata „	57, 58
304	Amnicola ? (Brazieria) Tasmanica. *T.-Woods* (Amnicola)	57, 58
305	——— (Beddomeia) Diemense. *Frauenfeld.* Previously referred to *Amnicola*	57, 58
306	——— „ Launcestonensis. *R. M. Johnston.* Referred to Petterd's new Subgenus Beddomeia	57, 58
307	——— „ Bellii. *Petterd*	57, 58
308	——— „ Lodderæ. „	57, 58
309	——— „ Hulli. „	57, 58
310	——— „ Tasmanica. *T.-Woods. Valvata;* T.-Woods	57, 58
311	Pomatiopsis striatula. *Menke*	57, 58
312	——— Badgerensis. *R. M. Johnston*	57, 58

(xxxvii.) Family ASSIMINIIDÆ. (sp 1.)

313	Assiminea bicincta. *Petterd*	57

(xxxviii.) Family VALVATIDÆ. (sp. 1.)

313a	*Valvata Tasmaniæ. T.-Woods.* Beddomeia, Tasmanica	57

(xxxix.) Family TRUNCATELLIDÆ. (sp. 4.)

314	Truncatella scalarina. *Cox.* Petterd's Monograph	27
315	——— Tasmanica. *T.-Woods.* Petterd's Monograph	27
316	——— marginata. Kuster. „ „	27
317	——— micra. T.-Woods. „ „	27

(xl.) Family NERITIDÆ. (sp. 1.)

318	Nerita atrata. *Quoy*	27

(xli.) Family LIOTIIDÆ. (sp. 15.)

319	Liotia Tasmanica. *T.-Woods*	27
320	—— discoidea. "	27
321	—— Australis. "	27
322	—— Angasi. "	27
323	—— minima. "	31
324	—— annulata. "	31
325	Cyclostrema *Kingii.* *Brazier*	27
326	———— Josephi. *T.-Woods*	27
327	———— micra. "	27
328	———— Weldii. "	27
329	———— Susonis. "	27
330	———— Spinosa. "	27
331	———— immaculata "	27
332	———— Bruniensis. *Beddome*	49
333	———— Johnstoni. "	49

(xlii.) Family ROTELLIDÆ. (sp. 1.)

334	Rotella (Ethalia) Tasmanica. T.-Woods	x

(xliii.) Family PHASIANELLIDÆ. (sp. 5.)

335	Phasianella tritonis. *Chemnitz*	27
336	———— sanguinea. *Reeve*	27
337	———— Angasi. *Jour. Conch, 1864*	27
338	———— rosea. *Angas*	27
339	———— delicatula. *T.-Woods*	27

(xliv.) Family TURBINIDÆ. (sp. 3.)

340	Turbo (Marmorostoma) undulatus. *Chemnitz*	27
341	——— (Senectus) circularis. *Reeve*	27
342	——— straminea. *Martyn*	27

(xlv.) Family TROCHIDÆ. (sp. 46.)

343	Trochus tæniata. *Quoy and Gaim.*	27
344	——— (Gibbula) Coxi. *Angas*	27
345	——— " sulcosa. *A. Adams*	27
346	——— (Zizyphinus) granulatus. *Born*	27
347	——— " armillatus. *Woods. Z. Meyeri, Philippi* (Br.)	27, 55
348	——— " fragrum. *Philippi*	27
349	——— " incertus. *Reeve*	27
350	——— (Monilea) *roseus. T.-Woods*	27
351	——— " *turbinatus.* "	27
352	——— (Minolia) *Tasmanicus.* "	27
353	——— (Infundibulum) fimbriata. *Swainson.* (*Carinidea.*) T.-Woods)	27

354	Trochus (Infundibulum) Tasmanica. (*Carinidea.*) (*Carinidea.* T.-Woods)	27
355	——— (Infundibulum) aurea. *Jonas.* (*Carinidea.* T.-Woods)	27
356	Trochus (Thalotia) conicus. *Gray.* *T. Picta,* T.-Woods (Br.) "	55, 27
357	——— " dolorosa. *T.-Woods*	55, 27
358	——— " tesselatus. "	31
359	——— " dubium. "	31
360	——— (Elenchus) badius. *Woods*	27
361	——— " bellulus. *Dunker*	27
362	——— " irisodontes. *Quoy*	27
363	——— " nitidulus. *Phil. Kust*	27
364	——— *Baudini*	44
365	——— (Cantharidus) pulcherrimus. *Gray*	55
366	——— " Lesueri. *Fischer.* (*T. picta,* T.-Woods)	55
367*	——— (Bankivia) varians. *Bech.*	27
368	——— (Trochochlea) Australis. *Favanne*	27
369	——— " constrictus. *Lam.*	27
370	——— " tæmatum ? *Quoy and Gaim*	27
371	——— " compta. *T.-Woods*	27
372	——— (Euchelus) canaliculatus. *Lam.*	27
373	——— " Tasmanicus. *T.-Woods.* (*Fossarus Tasmanica*) T.-Woods.	27
374	——— " scabriculus. *Ad. and Angas*	27
375	——— (Clanculus) nodulosus. *A. Adams*	27
376	——— " Aloysii. *T.-Woods*	27
377	——— " Philomenæ. "	27
378	——— " Dominicanæ. "	27
379	——— " Raphæli. "	27
380	——— " Angeli. "	27
381	——— " conspersus. *A. Adams*	27
382	——— " rubens. "	27
383	——— " undatus. *Lam.*	27
384	——— " Mangeri. *Adams*	27
385*	——— " variegatus. "	27
386	——— " gibbosus. "	27
387	——— " nodo-liratus " *Gibbula multicarinata, T.-Woods* (32)	27
388	(Astele) subcarinatus. *Swainson*	27

(xlvi.) Family STOMATELLIDÆ. (sp. 2.)

389	Stomatella imbricata. *Lam.*	27
390	Stomatia (Gena) strigosa. A. Adams	27

(xlvii.) Family PLEUROTOMARIIDÆ. (sp. 1.)

391	Schismope Atkinsoni. *T.-Woods.* (*Scissurella,* T.-Woods, 1876)	27

(xlviii.) Family Haliotidæ. (sp. 4.)

392	Haliotis nævosa. *Martyn*	27
393	——— glabra. *Swainson*	27
394	——— carinata. *Martini*	27
395	——— elegans. *Koch*	27

(xlix.) Family Fissurellidæ. (sp. 13.)

396	Fissurella Australis. *Krauss*	27
397	——— scutella. Gray	27
398	——— nigrita. *Sow.*	27
399	——— concatenata. *Crosse*	27
400	——— crucis. Beddome	49
401	——— (Machroschisma) Tasmanica. *T.-Woods.* (Var. a, *Rosea.*) (T.-Woods.)	27
402	Emarginula emarginata. *Blainville*	27
403	——— rugosa. (Quoy ?) *Sow.*	27
404	——— Tasmaniæ. *Sow.*	27
405	——— tenuicostata. "	27
406	Parmophorus elongatus. *Blainville.* (*Scutus* T.-Woods)	27
407	——— (Tugalia) Australis. *Sow.*	27
408	——— " Tasmanica. *T.-Woods*	27

(l.) Family Patellidæ. (sp. 16.)

409	Acmæa septiformis. *Quoy*	27
410	——— marmorata. *T.-Woods*	27
411	——— crucis. "	27
412	——— costata. *Sow.*	27
413	——— cantharus. *Reeve*	27
414	——— flammea. *Quoy*	27
415	——— conoidea. "	27
416	——— Petterdi. *T.-Woods*	27
417	——— alba. "	27
418	Patella aculeata. *Reeve*	27
419	——— tramoserica. *Martyn*	27
420	——— decora. *Philippi*	27
421	——— ustulata. *Reeve*	27
422	——— Tasmanica. *T.-Woods*	27
423	——— Chapmani. "	27
424	——— radians. *Gmelin*	27

(li.) Family Chitonidæ. (sp. 11.)

425	Chiton (Lophyrus) Australis. (*R. Mag. Nat. Hist.* 1840)	27
426	——— (Lepidopleurus) liratus. *Ad. and Angas*	27
427	——— " speciosus. "	27
428	——— piceus. *Gmel.*	27
429	——— proteus. *Reeve*	27
430	——— *Sinclairi* ? Gray	27

431	Chiton glaucus. "	27
432	——— (Plaxifora) petholatus. *Sow.* *C. ciliata.* Sow?	27
433	——— (Acanthochites) Zelandius. *Quoy.* Probably identical with *C. crinitas* Pennart, and *C. fasicularis*	27
434	Chitonellus (Cryptoplax) Gunni. *Reeve*	27
435	——— " spinosa. *A. Adams*	27

OPISTHOBRANCHIATA.

(lii.) Family PHILINIDÆ. (sp. 1.)

436	Philine aperta. *Linne*	27

(liii.) Family TORNATELLIDÆ. (sp. 2.)

437	Tornatina Mariæ. *T.-Woods*	27
438	Ringicula Australis. *Crosse*	27

(liv.) Family CYLICHNIDÆ. (sp. 2.)

439	Cylichna arachis. *Quoy and Sow.*	27
440	——— Atkinsoni. *T.. Woods*	27

(lv.) Family BULLIDÆ. (sp. 2.)

441	Bulla oblonga. *A. Adams*	27
442	Haminea obesa. *Sow.*	27

(lvi.) Family LOPHOCERCIDÆ. (sp. 1.)

443	Akera Tasmanica. *Beddome*	49

(lvii.) Family APLYSIIDÆ. (sp. 2.)

444	Aplysia concava. *Sow.*	27
445	——— Tasmanica. *T.-Woods*	27

PULMONATA.

(lviii.) Family VITRINIDÆ. (sp. 3.)

446	Vitrina Milligani. *Pfeiffer*	22, 34, 40
447	——— Verreauxi. "	22, 34, 40
448	——— fumosa. *T.-Woods*	34, 40

(lix.) Family HELICIDÆ. (sp. 73.)

449	Helix architectonica.	*Brazier*	22, 35, 40
450	—— antialba.	(*Beddome*	
451	—— Bassi.	*Brazier*	
452	—— Barrenensis.	*Petterd*	
453	—— bisulcata.	(Pfr.	
454	—— Bischoffensis.	*Beddome*	
455	—— cellaria.	*Mueller* *	
456	—— cæsus.	*Cox*	
457	—— Collisi.	*Brazier*	
458	—— Curaçoæ.	"	
459	—— Diemenensis.	*Cox*	
460	—— direlicta.	"	
461	—— dispar.	*Brazier*	
462	—— Du Cani.	*Cox*	
463	—— Dyeri.	*Petterd*	
464	—— Fordei.	*Brazier*	
465	—— Furneauxensis.	*Petterd*	
466	—— Gunni.	*Brazier*	
467	—— Gadensis.	*Beddome*	
468	—— Hamiltoni.	*Cox*	
469	—— Hobarti.	"	
470	—— Halli.	"	
471	—— Henryana.	*Petterd*	
472	—— Hookeriana.	*R. M. Johnston*	
473	—— jungermanniæ.	*Petterd*	
474	—— Kingi.	*Brazier*	
475	—— Kershawi.	*Petterd*	
476	—— lampra.	(Pfr.	
477	—— Launcestonensis.	*Reeve*	
478	—— Legrandi.	*Cox*	
479	—— lamproides.	"	
480	—— Luckmani.	*Brazier*	
481	—— limula.	*Cox*	
482	—— Langleyana.	*Brazier*	
483	—— Lottah.	*Petterd*	
484	—— Morti.	*Cox*	
485	—— mimosa.	*Petterd*	
486	—— marchianæ.	*Cox*	
487	—— M'Donaldi.	"	
488	—— Mathinna.	*Petterd*	
489	—— Nelsonensis.	*Brazier*	
490	—— Officeri.	*Cox*	
491	—— Otwayensis.	*Petterd*	
492	—— parvissima.	*Cox*	
493	—— positura.	"	
494	—— plexus	"	
495	—— Petterdi.	*Brazier*	
496	—— pictilis.	*Tate*	

* The three species so marked have been introduced from Europe, and are now abundant in Launceston and Hobart, in gardens or cellars.

497	Helix pulchella. *Mueller* *	
498	—— questiosa. *Cox*	
499	—— ruga 〃	
500	—— rotella. *Brazier*	
501	—— Roblini. *Petterd*	
502	—— Sinclairi. (Pfr.)	
503	—— subangulata. (Prf.)	
504	—— sitiens. *Cox*	
505	—— Stephensi. *Cox*	
506	—— subrugosa. *Brazier*	
507	—— Spiceri. *Petterd*	
508	—— Stanleyensis. 〃	
509	—— Savési. 〃	
510	—— Tasmaniæ. *Cox*	
511	—— tranquilla. 〃	
512	—— Trucanini. *Petterd*	
513	—— trajectura. *Cox*	
514	—— Tamarensis. *Petterd*	
515	—— vitrinaformis. *Cox*	
516	—— Wynyardensis. *Petterd*	
517	—— Weldii. *T.-Woods*	
517a	—— aspersa. 〃 *	
518	—— Brunonia. *R. M. Johnston*	56
519	Bulimus Dufresni. *Leach*	22, 35, 40
520	——— Tasmanicus. *Pfeiffer*	22, 35, 40

(lx.) Family PUPIDÆ. (sp. 1.)

521	Pupa Lincolnensis. *Angas*	48

(lxi.) Family LIMACIDÆ. (sp. 1.)

522	Limax Legrandi. *Tate*	42

(lxii.) Family ARIONIDÆ. (sp. 1.)

523	Cystopelta Petterdi. *Tate*	42

(lxiii.) Family SUCCINEIDÆ. (sp. 4.)

524	Succinea Legrandi. *Cox*	22, 35, 40
525	——— Australis. *Pfeiffer*	22, 35, 40

(lxiv.) Family AURICULIDÆ. (sp. 4.)

526	Cassidula zonata. *H. and A. Adams.* *Auricula Dyerana,* T.-Woods, 27	32
527	Alexia Harrissoni. *Beddome*	49
528	Marinula pellucida. *Cooper*	27
529	Ophicardelus cornea. *Swainson.* *Auricula Australis.* Martyn	27

(lxv.) Family LIMNÆIDÆ. (sp. 27.)

530	Limnæa Sub-aquatilis. *Tate.* Var. a neglecta ...	57
531	——— Gunnii. *Petterd*	57
532	——— lutosa. "	57
533	——— stagnalis " (Introduced)	57
534	Amphipeplea Launcestonensis. *T.-Woods*	33, 57, 58
535	———— " ? (Var. *Papyracea*) Tate...	57
536	Physa Van Diemenensis. Sow.	Possibly var. of *P. nitida* 28, 33, 45, 58
537	—— aperta "	
538	—— nitida. "	
539	—— *Huonensis. T.-Woods*	
540	—— Bruniensis. "	
541	—— Tasmanicola "	
542	—— Huonicola. "	
543	—— eburnea. *Sow.*	
544	—— *attenuata.* "	
545	—— mamillata. "	
546	—— *Tasmanica ? T.-Woods*	Possibly a var. of *P. nitida*
547	—— *Legrandi ? T.-Woods.* Possibly a var. of *P. nitida*	
548	Planorbis meridionalis. *Brazier*	*P. Tasmanicus.* T.-Woods 33, 58, 57
549	——— Atkinsoni. *R. M. Johnston*	
550	——— Scottiana. "	
551	——— *Australianus.* Martens. Probably identical with *P. meridionalis.*	
552	Ancylus Cumingianus. *Bourg.*	28, 33, 58
553	——— *Irvinæ ? Petterd.* Probably large variety of the variable *A. Cumingianus*	57, 58
554	——— Tasmanicus. *T.-Woods*	28, 33, 58
555	Gundlachia Petterdi. *R. M. Johnston*	33, 58
556	———— *Beddomei ? Petterd.* Probably a variety of *G. Petterdi*	57

(lxvi.) Family AMPHIBOLIDÆ. (sp. 3.)

557	Amphibola (Ampullarina) fragilis. *Quoy*	27
558	——— " Quoyana. *Desh.*	27
559	——— " minuta. *T.-Woods*	27

(lxvii.) Family SIPHONARIIDÆ. (sp. 3.)

560	Siphonaria Diemenensis. *Quoy*	27
561	——— denticulata. *Quoy and Gaim*	27
562	——— zonata. *T.-Woods*	27

CLASS SCAPHOPODA.

(lxviii.) Family DENTALIIDÆ. (sp. 2.)

563	Dentalium Tasmaniensis. T.-Woods	27
564	——— Weldiana. "	27

Class PELECYPODA.

(SINUPALLIATA.)

(lxix.) Family Gastrochænidæ. (sp. 2.)

565	Aspergillum (Humphreya) Strangei	27
566	Gastrochæna Tasmanica. *T.-Woods*	27

(lxx.) Family Teredidæ. (sp. 1.)

567	Teredo navalis. *Gray*	27

(lxxi.) Family Pholadidæ. (sp. 1.)

568	Barnea Australasiæ. *Gray*	27

(lxxii.) Family Solenidæ. (sp. 1.)

569	Solen vaginoides. *Lam.*	27

(lxxiii.) Family Saxicavidæ. (sp. 2.)

570	Saxicava Australis. *Lam.*	27
571	Panopæa Australis. Sow	27

(lxxiv.) Family Corbulidæ. (sp. 3.)

572	Corbula *Zelandica ?* Quoy. (Doubtful.) T.-Woods	27
573	——— erythrodon. *Lam.* " "	27
574	Neræa Tasmanica. *T.-Woods*	27

(lxxv.) Family Anatinidæ. (sp. 11.)

575	Anatina anserifera. *Spengler*	27
576	——— creccina. *Valence*	27
577	——— Tasmanica. *Reeve*	27
578	——— Angasi. *Crosse*	27
579	Myodora brevis. *Stutchbury*	27
580	——— *ovata ? Reeve.* (Doubtful if identical with *Reeves'* species. (T.-Woods)	27
581	——— pandoriformis. *Stutchbury*	27
582	——— Tasmanica. *T.-Woods*	27
583	——— albida. "	27
584	Myochama anomioides. *Stutchbury*	27
585	——— (sp. indet)	27

(lxxvi.) Family Mactridæ. (sp. 4.)

586	Mactra rufescens. *Lam.*	27
587	——— pura. *Deshayes*	27
588	——— cretacea. Angas	27
589	Lutraria dissimilis. *Deshayes*	27

(lxxvii.) Family PAPHIIDÆ. (sp. 5.)

590	Paphia (Anapa) triquetrum. *Hanley*	27
591	——— „ Tasmanica. *T.-Woods.* Possibly a variety of *P. triquetrum*	27
592	——— (Donacilla) elongata. *Deshayes*	27
593	——— (Mesodesma) erycina. *Lam.*	27
594	——— „ precæsia. *Deshayes*	27
595	——— „ Diemenensis. *Quoy and Gaim*	44

(lxxviii.) Family SEMELIDÆ. (sp. 3.)

596	Semele decora. *A. Adams*	27
597	——— exigua. *H. Adams*	27
598	——— Warburtoni. *T.-Woods*	27

(lxxix.) Family TELLINIDÆ. (sp. 13.)

599	Tellina deltoidalis. *Lam.*	27
600	——— albinella. „	27
601	——— umbonella „	44
602	——— diemenensis. *Deshayes*	27
603	——— Tristis. „	27
604	——— (Arcopagia) decussata. *Lam.*	27
605	——— Mariæ. *T.-Woods*	27
606		
607	Gari compta. *Deshayes*	27
608	—— zonalis. *Lam.*	27
609	—— Atkinsoni. *Brazier*	27
610	Hiatula epidermia. *Deshayes*	27
611	——— vitrea. „	27

(lxxx.) Family VENERIDÆ. (Sp. 26.)

612	Venus (Chione) Humphreyi. *Donovan*	27
613	——— „ conularis. *Lam.* } *V. Aphrodinoides*	27
614	——— „ lamellata. „ } *V. Scalarina*	27
615	——— „ Stutchburyi. *Gray*	27
616	——— „ roborata. *Hanley*	27
617	——— „ gallinula. *Lam.*	27
618	——— „ Macleayana. *T.-Woods*	27
619	——— „ striatissima. *Sow.*	27
620	——— „ Australis. „	27
621	——— „ lævigata. „	27
622	——— „ *fumigata* ? „ Doubtful species	27
623	———	
624	Cytherea (Callista) Diemenensis. Hanley	27
625	——— „ planatella. *Chemnitz* ?	27
626	——— „ *candida* ? Deshayes. Unknown. (T.-Woods)	27
627	——— „ disrupta. *Sow.*	27
628	——— „ *citrina* ? *Lam.*	27

629	Cytherea (Callista) *rutila ?* *Deshayes.* Doubtful. (T.-Woods)	27
630	——— 〃 Victoriæ. *T.-Woods*	27
631	——— (Gouldia.) Petterdi. 〃	27
632	Dosinia grata. *Deshayes*	27
633	——— *japonica ? Reeve.* Doubtful. (T.-Woods.)	27
634	——— *coryne. A. Adams*	27
635	——— crocea. *Deshayes*	27
636	——— immaculata. *T.-Woods*	27
637	Tapes undulata. *Born.* Rare.	27

INTEGRIPALLIATA.

(lxxxi.) Family Cyrenidæ. (sp. 4.)

638	*Corbicula Brunnea ?* Prime. Doubtful	44
639	Pisidium Tasmanicum. *T.-Woods*	28
640	——— Dulvertonensis. 〃	28
641	Sphærium (Cyclas) Tasmanica. *T.-Woods*	28

(lxxxii.) Family Petricolidæ. (sp. 6.)

642	Rupellaria Diemenensis. *Quoy and Gaim*	27
643	——— *brevis ?* 〃 Doubtful.	27
644	——— reticulata. *T.-Woods*	27
645	——— crenata. *Lam.*	27
646	——— sub-decussata. *Deshayes*	27
647	——— carditoides. *Lam.*	27

(lxxxiii.) Family Cardiidæ. (sp. 4.)

648	Cardium tenuicostatum. *Lam.*	27
649	——— pulchellum. *Reeve*	27
650	——— *papyraceum ? Chemnitz.* Probably var. of *C. tenuicostatum*	27
651	——— cygnorum. *Deshayes*	27

(lxxxiv.) Family Chamidæ. (sp. 1.)

652	Chama (sp. indet)	27

(lxxxv.) Family Lucinidæ. (sp. 4.)

653	Lucina (Cyclas) divaricata. *Linne*	27
654	——— 〃 minima. *T.-Woods*	27
655	——— 〃 pecten. *Lam.*	27
656	Loripes icterica *Reeve*	27

(lxxxvi.) Family Ungulinidæ. (sp. 1.)

657	Mysia Tasmanica. T.-Woods. *Diplodonta.* T.-Woods	27

(lxxxvii.) Family Erycinidæ. (sp. 4.)

658	Lassea (Poronia ? australis. *Sow*	27
659	—— „ ? scalaris. *Phil.*	27
660	Kellia Atkinsoni. *T.-Woods*	27
661	—— (Pythina) Tasmanica, *T.-Woods*	27

(lxxxviii.) Family Crassatellidæ. (sp. 3.)

662	Crassatella Kingicola. *Lam.*	27
663	——— aurora. *Ad. and Angas*	27
664	——— Banksii. „	27

(lxxxix.) Family Astartidæ. (sp. 6.)

665	Cardita Raouli. *Angas*	27
666	—— Quoyi. *Deshayes*	27
667	—— Gunni. „	27
668	—— amabilis. „	27
669	Mytilicardia Tasmanica. *T.-Woods*	27
670	——— *excavata.* *Deshayes*	27

HOMOMYARIA.

(xc.) Family Unionidæ. (sp. 1.)

671	Unio *Moretonicus?* Reeve. Very variable in form, probably one of the many varieties of *U. Australis*	28, 59

(xci.) Family Trigoniidæ. (sp. 1.)

672	Tregonia Margaritacea. *Lam.*	27

(xcii.) Family Nuculidæ. (sp. 4.)

673	Nucula Grayi. *D'Orb.*	27
674	—— minuta. *T.-Woods*	27
675	Leda crassa. *Hinds*	27
676	—— Lefroyi. *Beddome*	49

(xciii.) Family Arcidæ. (sp. 9.)

677	Arca trapezia. *Desh.*	27
678	—— fasciata. *Reeve*	27
679	—— *semitorta.* *Lam.*	44
680	—— *pistachia* „	44
681	—— *squamosa* „	44
682	Pectunculus radians „	27
683	——— obliquus. *Reeve* ?	27
684	——— *flabellatus.* *T.-Woods.* *P. orbicularis* Angas ?	44
685	Limopsis Tenisoni. *T Woods.*	27

HETEROMYARIA.

(xciv.) Family MYTILIDÆ. (sp. 10.)

686	Mytilus latus. *Lam.*	27
687	——— *Tasmanicus.* *T.-Woods.* Doubtfully distinct from last	27
688	——— Dunkeri. *Reeve*	27
689	——— rostratus. *Dunker*	27
690	——— hirsutus. *Lam.*	27
691	——— crassus. *T.-Woods*	27
692	Modiola Australis. Gray. Doubtfully distinct from *M. tulipa.* (T.-W.)	27
693	——— albicostata. *Lam.*	27
694	——— arborescens. *Chemnitz*	27
695	Modiolaria Cumingiana. *Dunker*	27

(xcv.) Family AVICULIDÆ. (sp. 4.)

696	Avicula pulchella. *Reeve*	27
697	——— (Meleagrina) *alba.* *Lam.*	4[illegible]
698	Crenatula *modiolaris.* *Lam.*	44
699	Vulsella Tasmanica. *Reeve*...	27

(xcvi.) Family PINNIDÆ. (sp. 1.)

700	Pinna Tasmanica. *T.-Woods*	[illegible]

MONOMYARIA.

(xcvii.) Family SPONDYLIDÆ. (sp. 1.)

701	Spondylus tenellus. *Reeve*	27

(xcviii.) Family PECTINIDÆ. (sp. 5.)

702	Pecten meridionalis. *Tate.* 54. *P. fumatus.* Linne. T.-Woods	[illegible]
703	——— asperrimus. *Lam.*	27
704	——— bifrons. "	27
705	——— Atkinos. *Petterd.* Allied to *P. asperrimus* ...	58
706	——— Mariæ. *T.-Woods*	[illegible]

(xcix.) Family LIMIDÆ. (sp. 2.)

707	Lima (Radula ?) lima. *Linne*	[illegible]
708	——— " bullata. *Born*	[illegible]

(c.) Family ANOMIIDÆ. (sp. 1.)

709	Placunanomia *Zealandica ?* Gray. Doubtful ...	

S, ORDEEDERS.

SUB-CLASS

ished with	Respffected by	Shell.
beaks... ...	Plume-li	Internal.
ature... ...	Branchiaming discs ...	Internal, external, or absent.
"	Gills or disc	Mostly univalve, spiral, or conical.
tentacles ...	Branchiæ	Straight or curved tube.
eaflets ...	Gills onatrophied ...	Bivalve hinged.
its	Mantle lng; fixed in	Bivalve with perforated beak.

SUB-ORDER

Disting

... ...	(Fam.	i.	——	ii.	)
... ...	"	iii.	——	v.	)
... ...	"	vi.			)
l	"		——		)
... ...	"		——		)
... ...	"	vii.	——	xxxix.	)
t anterior canal	"	xl.	——	l.	)
" "	"	xl.	——	xlviii.	)
" "	"	xlix.	——	l.	)
separate pieces	"			li.	)
nming by means of fir... ...	"	—	——	—	)
e mantle	"	lii.	——	lvii.	)
to cavities in mantle	"	—	——	—	)
the anus	"	—	——	—	)
... ...	"	—	——	—	)
perior pair of tentacles... ...	"	lviii.	——	lxiii.	)
" "	"	lviii.	——	lxiii.	)
" "	"	—	——	—	)
ned and triangular	"	lxiv.	——	lxviii.	)
ments rugose	"			lxiv.	)
" smooth	"			lxv.	)
brackish water ; head... ...	"	lxvi.	——	lxvii.	)
not spiral	"		——	lxviii.	)
... ...	"	lxix.	——	lxxxix.	)
... ...	"	lxix.	——	lxxx.	)
nus	"	lxxxi.	——	lxxxix.	)
... ...	"	xc.	——	ci.	)
... ...	"	xc.	——	xciii.	)
r large	"	xciv.	——	xcvi.	)
... ...	"	xcvii.	——	ci.	)
generally supported b... ...	"			cii.	)
arms free, not suppc... ...	"	—		—	)

6

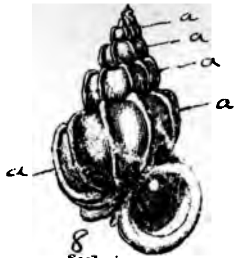
Ranella

Frog sh

7

Phasianella *australis*

Pheasant



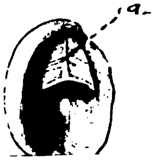
8

Scalaria *pretiosa*,

Wentle trap

/

otoides



(ci.) Family OSTREIDÆ. (sp. 4.)

710	Ostrea *edulis*? *Linne*	27
711	——— mordax. *Gould*	27
712	——— rutupina. *Jeff*	27
713	——— Angasi. *Sow.*	27

MOLLUSCOIDA.

CLASS BRACHIOPODA.

(cii.) Family TEREBRATULIDÆ. (sp. 3.)

714	Waldheimia flavescens. *Lam.*	27
715	Kraussia Lamarckiana. Davidson	27
716	——— Atkinsoni. *T.-Woods*	27

CORRIGENDA.

Page	7	FOR	Pelecypooa	READ	Pelecypoda.
"	38	"	Trochocochlea	"	Trochochlea.
"	48	"	Parnea	"	Barnea.
"	74	"	Arosalpinx	"	Urosalpinx.
"	76	"	Ancillari	"	Ancillaria.
"	"	"	Aesopus	"	Æsopus.
"	77	"	Cancellari	"	Cancellaria.
"	"	"	Cythara	"	Cithara.
"	78	"	Cassmaria	"	Casmaria.
"	79	"	Cirostrema	"	Cirsotrema.

DESCRIPTION OF A SECOND GANOID FISH FROM THE LOWER MESOZOIC SANDSTONES NEAR TINDER-BOX BAY.

By Messrs. R. M. Johnston and A. Morton.

On the 19th August, 1889, we had the pleasure of bringing under the notice of the members of this Society a new Ganoid Fish, from the Knocklofty sandstones, and named *Acrolepis Hamiltoni*, in honour of our worthy President, Sir Robert Hamilton. We have now the honour of giving a full description of a second species of the same genus recently discovered in a sandstone formation near Tinder-Box Bay, deemed to be nearly of the same geological horizon as the sandstones of Knocklofty.

Acrolepis Tasmanicus. *n. sp. Johnston and Morton.*

Body compressed, elongate, elliptical; length from snout to end of caudal fin, nearly 6 inches; length of head, 14 lines; length of body, 4½ inches; snout projecting beyond lower jaw; greatest depth, 14 lines; least depth at peduncle, 5 lines. Dorsal fin somewhat falcate, composed of 48 to 50 slender rays (6 to a line) each one of which branches into two or three sub-divisions near extremities, and each one or two rays crossed distantly and in a curved manner by fine oblique ridges; base, 8¾ lines long, occupying a position nearer the tail than the snout, anterior end being 37 lines distant from snout, and the posterior end 45¾ lines; greatest length of dorsal (2nd, 3rd and 4th longest) same as base, 8¾ lines; the longer anterior rays curve over the anterior ones, which abruptly diminish in size, the posterior margin being thus irregularly vertical. Anal fin about the same size and composed of nearly the same number of rays as the dorsal fin, but its position is nearer the tail, the anterior portion commencing about 40 lines from the snout, and the posterior terminating about 48¾ lines distant. Ventral fin composed of about 18 fine rays, central, and well in advance of anal fin. Pectoral, imperfect, somewhat elongate, and consisting of numerous fine rays, which become subdivided towards extremities as in the dorsal fin. Rays of sub-caudal fin numerous, fine; fin elongate, nearly equal in length to the slightly elevated caudal extremity,* and forming with it a bifurcation which is almost as symmetrical as the true homocercal forms; the rays on the lower margin of the true tail lobe form a narrow inconspicuous fringe. All the rays of caudal extremity are extremely fine, about 21 in the space of 12 lines, those of the sub-caudal fin are crossed repeatedly with curved, raised lines, composed of short, oblique ridges as in dorsal fin.

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* Length of caudal lobe (upper), 19 lines; length of sub-caudal fin, 14 lines; distance between extreme tips of caudal furcation, 15½ lines.

There are about 64 rows of small rhomboid scales or plates longitudinally arranged in an inclined and slightly curved dorso-ventral series. The transverse series varies considerably in number and depth; there being about 18 in oblique transverse series near peduncle, and about 35 near the shoulder; the scales are greatest in depth towards the lateral line, diminishing greatly as they approach dorsal and ventral margins; the base of each scale runs parallel nearly with others of the longitudinal series, and in a general view seem to divide the surface into fine parallel rows, which cut the more or less curved oblique transverse series into an oblique rhomboid pattern.

Each scale or plate is ornamented on the upper surface with the peculiar furcated raised linear ridges of the genus *Acrolepis*; these forked ridges seem to radiate from a point at the lower posterior angle and fork once or twice, upward and forward, in the direction of the anterior upper angle. This furcation reminds one of the forking neuration on the lobes of many species of ferns, and is very remarkable. Fortunately a portion of the fossil shows the under surface, and each scale of these series is characterised by a small tooth-like projection in the centre of each upper margin, with a corresponding raised socket on lower surface half the depth of scale, into which the tooth of each scale respectively of the lower series scale fits closely. Both socket and tooth have an angle corresponding to the direction of the transverse serial lines; the ornamentation of the scales forming the lateral line differs from all the others, as the fine furcate lines radiate more nearly from the centre of posterior margin, half of which curve upwards, and the other half downwards. As a rule the linear ridges are fewer in number relative to size of scale in the lateral line series.

This fine specimen was obtained from the Lower Mesozoic Sandstones near Tinder-Box Bay.* A group probably belonging nearly to the same geological horizon as the Knocklofty sandstones, Hobart, from which was obtained the remains of *Acrolepis Hamiltoni*, recently described by us in the Proc. of the Royal Soc. of Tas. (1889). The species here described is much better preserved, and though closely allied to the former it is very distinct. The chief differences are the greater prolongation of the sub-caudal fin, giving greater symmetry to the caudal fork; the greater number of scales or plates in the lateral and transverse series; and also the relatively greater development of the vertical fins.

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* In p. 149, "Johnston's Geology of Tasmania," these sandstones are described as "a series of reddish or yellow micaceous sandstones, sometimes of great thickness, often occur overlying the uppermost beds of the Upper Palæozoic Mudstones as at Tinder-Box Bay, Huon-road, and Waterworks Valley, near Hobart, with indistinct plant impression and silicified trunks of conifer. These sandstones apparently lie conformably and without stratigraphic break upon the uppermost beds of the Upper Marine series (Up. Pal.). Their position is assigned provisionally at the base of the Mesozoic rocks of Tasmania."—*(Johnston.)*

The ornamentation of the scales or plates, although of the same character, also appear to be much finer. The position and relative dimensions of fins also differ to some extent.

Good photographs have been taken of the two sections disclosed by the splitting of the rock in which the specimen was imbedded.

Along with these are given magnified views of the under and upper surface of the scales or plates, and also an enlarged view of the dorsal fin, showing the subdivided extremities of rays. The fine series of fulcral scales can be discerned forming a serration along the anterior margin of dorsal fin. There is a probability of a larger number of these interesting fish remains being obtained when operations in certain quarries are again carried out.

THE DISCOVERY AND OCCUPATION OF PORT DALRYMPLE.

BY JAMES BACKHOUSE WALKER.

1. THE DISCOVERY.

It is a fact, often forgotten, that an interval of a century and a half separated the discovery of the eastern coast of Australia from that of her western shores. The western coast was visited by the Dutch in the early part of the 17th century. It was not until the last half of the 18th that the eastern coast was first seen by European eyes. The discovery of Southern Tasmania belongs to the old period—to the days of the Dutch East India Company, and of Tasman's search for the Great South Land—to the days when New Holland had an evil reputation as the most forbidding and inhospitable country on the face of the earth. The discovery of our northern coast was one of the last of the modern epoch, when English navigators had laid open to the world the rich promise of the fertile lands of Eastern Australia, and when the first of the great English southern colonies had already been planted at Port Jackson.

A short sketch of the exploration of the Straits, and particularly Port Dalrymple, although it may traverse some ground already touched upon in former papers, may prove of interest as an introduction to the story of the settlement of Northern Tasmania. Such a sketch will serve to bring into due prominence the achievements of two men, whose names should be held in honour by every Tasmanian, as practically the discoverers of our island home and the pioneers who opened it for English colonisation. These two men were George Bass and Matthew Flinders.

I trust, therefore, that my readers will forgive my detaining them for a time from the settlement of Port Dalrymple by a prefatory history of the events which led to its discovery.

The existence of a great southern continent surrounding the antarctic pole and pushing itself northward far into the Pacific Ocean was a fixed belief of the old geographers. The hope of discovering such a continent prompted not only the voyage of Abel Tasman towards the unknown South Land in 1642, when he discovered the southern coast of Van Diemen's Land, but many another expedition of the old navigators. As is well known, Captain Cook's first voyage in the *Endeavour*, in 1768, was undertaken for the purpose of observing the transit of Venus from a station in the South Seas. But when the observations had been made, Cook, in accordance with his instructions, headed the *Endeavour* from Tahiti to the far south, to make one more effort to solve the old geographical problem. After reaching lat. 40° S. without seeing any sign of land, he turned north and then west until he sighted what he at first took for the long-sought Terra Australis Incognita. It is scarcely necessary to say that this was the east coast of New Zealand. After circumnavigating the islands, in March, 1770, the question arose as to the homeward route. Cook himself had a strong desire to return by Cape Horn in order finally to determine whether there was or was not a continent in that direction. As, however, winter was approaching, it was thought inadvisable to venture into the stormy seas of those high latitudes. It was resolved, therefore, to return by the East Indies, and with this view to sail westward until they should fall in with the undiscovered east coast of New Holland, and then follow that coast to its northern extremity. The *Endeavour* took her departure from Cape Farewell, and on 19th April, 1770, sighted land at Point Hicks, about 60 miles westward of Cape Howe. Cook had expected to see the coast of Tasman's Van Diemen's Land to the south, and from the sudden falling of the sea concluded that it was not far off, but was not able to determine whether it was joined to New Holland or not. From Point Hicks he sailed north, exploring the whole length of the eastern coast, which he named New South Wales, until he reached its northern extremity at Cape York, and returned home by Torres Straits.

Cook's First Voyage, ii., 282.

Ibid., ii., 433.

Ibid., ii., 483.

Two years later, Cook sailed on his second voyage in the *Resolution*. He was accompanied by the *Adventure*, commanded by Capt. Tobias Furneaux. The ships were separated in a fog in 50° S. lat., between the Cape and New Zealand, and Furneaux shaped his course for the land marked on the charts as Van Diemen's Land, which he sighted on 5th March, 1773. After a short stay he sailed out of Adventure Bay with the intention of exploring the east coast as far as Point Hicks, Cook's most southern point, in order to discover whether the coast of

Van Diemen's Land was joined to that of New Holland. The *Adventure* sailed northwards till land was lost sight of a little to the north of the Furneaux Group, but continuing a northerly course Furneaux saw, or fancied he saw, land again in about lat. 39°. Here the soundings indicated the presence of shoals, and thinking the navigation too dangerous, he stood away for New Zealand. His conclusion is thus expressed:—"It is my opinion that there is no strait between New Holland and Van Diemen's Land, but a very deep bay."

Cook's Second Voyage, i., 115.

No further exploration in that direction took place before the settlement of Port Jackson in 1788, and for years subsequently the resources of the new colony were too limited to allow of more than boat expeditions to short distances from the Sydney Heads.

In June 1797, however, the wreck of a vessel named the *Sydney Cove*, on Cape Barren Island in the Furneaux Group, led to the despatch of the colonial schooner *Francis* to the scene of the wreck. The trips of the *Francis* not only extended geographical knowledge, but aroused a keen interest in the locality, as the seat of a most lucrative seal fishery.

Flinders' Voyage, Intro. 104.
Hunter to Portland, 6 July, 1797.

Just at this time H. M. S. *Reliance* arrived at Port Jackson from the Cape of Good Hope, with a cargo of cattle. She was in a very leaky condition, and had to be detained for extensive repairs. Amongst her officers were two eager and adventurous spirits, her Second Lieut., Matthew Flinders and her Surgeon, George Bass. They were both young—Flinders was 23—both ardent and full of zeal for exploration. On a previous voyage of the *Reliance* they had made a daring expedition down the coast in a boat only 8 feet long, and Bass had travelled inland to try to cross the Blue Mountains. On this occasion Flinders could not leave his ship, but Bass, tired of inaction, prevailed on Governor Hunter to lend him a whaleboat for a more extended voyage. The Governor gave him a boat, six weeks' provisions, and a crew of six seamen from the King's ships. In this whaleboat Bass made his way down the coast, examining the inlets and harbours, and battling with head winds and gales, for a distance of more than 600 miles. Rounding Cape Howe, and passing Cook's furthest point (Cape Hicks), he sighted the high land afterwards known as Wilson's Promontory, but the contrary winds preventing him from reaching it, he stood across for the Furneaux Islands, where he hoped to replenish his stock of provisions. The wind, however, now drove him to the south-west, and as

26 June, 1797, Collins' New South Wales, ii., 318.

Flinders' Voyage, Intro., 106.

the gale and sea increased, the water rushed in fast through the boat's side, and he was obliged to go on the other tack. After a time of considerable danger he once more reached the Promontory, this time on the west side, and proceeding along the coast, discovered and entered Western Port. He was detained in the Port for a fortnight by contrary gales, and as the seventh week of absence from Port Jackson had expired, want of provisions forced him very reluctantly to turn the boat's head homeward. On his way back he examined Wilson's Promontory, and came to the conclusion from various indications that there must be a strait between Van Diemen's Land and the mainland. He found that the flood-tide swept westward past the Promontory at the rate of two or three miles an hour, the ebb setting to the eastward. "Whenever it shall be decided," he says in his journal, "that the opening between this and Van Diemen's Land is a *strait*, this rapidity of tide, and the long south-west swell that seems to be continually rolling in upon the coast to the westward, will then be accounted for." Strong contrary gales delayed Bass on his homeward voyage, and it was not until after an absence of 12 weeks, during a great part of which he and his crew had subsisted chiefly on mutton-birds, that he returned to Port Jackson, and reported his discoveries to Governor Hunter.

Flinders' Voyage, Intro., 117.

1 March, 1798. The Governor, in his despatch to the Duke of Portland, says that Bass "found an open ocean westward, and, by the mountainous sea which rolled from that quarter, and no land discoverable in that direction, we have much reason to conclude that there is an open strait through, between the latitude of 39° and 40° 12′ S., a circumstance which, from many observations made upon tides and currents, I had long conjectured . . . I presume it will appear that the land called Van Diemen's, and generally supposed to be the southern promontory of this colony, is a group of islands separated from its southern coast by a strait, which it is probable may not be of narrow limits, but may perhaps be divided into two or more channels by the islands near that on which the *Sydney Cove* was wrecked."

Flinders' Voyage, Intro., 120.

During Bass' absence in the whaleboat the ***Francis*** was again sent to the wreck, and this time Flinders accompanied her. The schooner went as far south as the entrance of Banks' Strait, and Flinders got his first sight of the north coast of Van Diemen's Land. The smoke rising from the land showed that there were inhabitants

Ibid., 120.

on it, and as there were none on the adjoining islands, Flinders was shaken in his belief in the existence of a strait, for he could not understand how, unless by a connecting isthmus, men could have reached the more distant Van Diemen's Land and yet failed to have attained the intervening islands, more especially as those islands were so abundantly supplied with birds and other food.

When Flinders met Bass in Sydney and heard of his observations at Wilson's Promontory, he declared that there wanted no other proof of the existence of a strait than that of sailing positively through it ; and this the two friends now anxiously waited for an opportunity to do. Their professional duties, however, delayed the execution of the project, but six months later when the *Reliance* returned from her voyage to Norfolk Island, Flinders explained his views to Governor Hunter, and the Governor gave him the *Norfolk*, a sloop of 25 tons, with a crew of eight volunteers, to attempt the circumnavigation of Van Diemen's Land. This voyage was briefly mentioned in a former paper, and it is not now necessary to follow it in detail, except so far as concerns our immediate subject, the discovery of Port Dalrymple. On the 7th October 1798, Flinders and Bass sailed in their tiny vessel on their now famous voyage. Their first point was Cape Barren Island, and thence they sailed through Banks' Strait and proceeded along the north coast of Tasmania. On the 3rd November, at two o'clock in the afternoon, Flinders saw with great interest indications of an opening in the land, and bore up for it. The vessel advanced rapidly with the flood tide, and, rounding a low head, entered a broad inlet. Sailing up this inlet some three miles, they passed a low green island, when suddenly the sloop grounded. Fortunately the ground was soft, the strong flood dragged the sloop over into deep water, and drove her rapidly onward till the harbour suddenly expanded into a broad and beautiful basin, on which swam numbers of black swans, duck, and wild fowl. Its shores were broken into points and projections, covered with wood and grass down to the water's edge,—a strong contrast to the rocky and sterile banks observed in sailing up Port Jackson. There appeared to be three arms or rivers discharging themselves into this extensive basin, and, as evening was coming on, the sloop was anchored near to the mouth of the western arm. Flinders was greatly pleased with his discovery, to which Governor Hunter gave the name of

Flinders' Voyage, Intro., 138.

Ibid., 152.

Port Dalrymple, in compliment to Alexander Dalrymple, the well known Hydrographer to the Admiralty. He employed 16 days in examining the place, explored Western and Middle Arms, worked his way up Whirlpool Reach, and got as far as Shoal Point and Crescent Shore, when, although he believed that half the river was still unexplored, the limited time allowed him compelled his return. The *Norfolk* took her departure from Low Head, and, sailing along the north coast, rounded Cape Grim, her commander finally settling the problem of the insularity of Van Diemen's Land by his circumnavigation.

The importance of the discovery was at once recognised in England; and early in 1800 the *Lady Nelson*, a brig of 60 tons, was fitted out and despatched under Lieut. Grant to examine the new strait. It was, however, left to Flinders himself in the *Investigator* two years later, to complete his own work by making the first reliable survey of its northern shores.

As we have already seen, the discovery of Bass Strait, and the possible colour it might give to French claims to the island, were among the causes which prompted King's hasty occupation of the Derwent by Bowen in 1803; and it was owing to King's urgent representations of the importance of forming settlements in the Straits to assist the seal fisheries and anticipate the French that Governor Collins' expedition was despatched to Port Phillip. When Governor Collins found his position at Port Phillip untenable, he was doubtful whether he should not remove his people to Port Dalrymple rather than to the Derwent. Governor King was also, in the first instance, strongly in favour of the northern locality, considering it more advantageously situated for the principal settlement in Van Diemen's Land, chiefly on account of the protection it would afford to English sealers in the Straits from the attacks of American interlopers. His only doubt was whether the soil was as good as that on the Derwent, and whether the entrance to the port was not too dangerous. To enable Governor Collins to satisfy himself on these points, he sent the schooner *Francis* to Port Phillip to serve as a surveying vessel. She was in a very leaky condition, and though they tried to patch her up at Port Phillip, and sent her, with William Collins, Clark, the agricultural superintendent, and Humphreys, the mineralogist, to make an examination of Port Dalrymple, she proved so unseaworthy that William Collins had to send her back to

King's Despatch, 21 May, 1802.

King to Collins, 26 Nov., 1803.

King to Woodriffe, 26 Nov., 1803.

Collins to King, 27 Jan., 1804.

Sydney and complete his voyage in the *Lady Nelson*, which he fell in with at Kent's Group.

The *Lady Nelson* entered Port Dalrymple on New Year's Day 1804. William Collins immediately proceeded with his examination. The *Lady Nelson* anchored above Upper Island (now Pig Island), and from thence the examination of the yet unvisited portion of the river was made in a boat. William Collins was delighted with the appearance of the country about the present site of Launceston, diversified with hill and plain, with good land both for pasture and agriculture. He went some distance up the Main River (North Esk) and found excellent land. Then he entered the Cataract Gorge. Grand as its towering rocks are now, the Gorge in its natural state, when clothed with the wild beauty of its native bush, and full of wild fowl, must have been magnificent. William Collins says of it: "The beauty of the scene is probably not surpassed in the world. The great waterfall or cataract is most likely one of the greatest sources of this beautiful river, every part of which abounds with swans, ducks, and other kinds of wild fowl. On the whole I think the River Dalrymple possesses a number of local advantages requisite for a settlement." Collins' Report, January, 1804. Clark's Report.

Collins had been 18 days in Port Dalrymple, and was anxious to get back to the Lieutenant-Governor with his good news. A fair wind carried the *Lady Nelson* across the Straits in two days, and on the 21st January Lieutenant Symons brought his ship to an anchor off the Camp, inside Port Phillip Heads. The Camp was a scene of busy activity, and when Wm. Collins landed to present his report, he found that the Lieutenant-Governor had at last made up his hesitating mind, and that the establishment was on the point of sailing to the Derwent. Collins to King, 28 Feb., 1804.

It so happened that Governor King had heard such a bad account from the captain of a schooner which had touched at Port Dalrymple for water, who painted such a picture of the dangers of the entrance and the hostile attitude of the blacks, that he had written advising Collins to give up all idea of the northern port. The Lieutenant-Governor, therefore, had the satisfaction before sailing of having his superior officer's approval of his final choice. King to Collins, 30 Dec., 1803.

The reports of the explorers had now lost their immediate interest, and the Lieutenant-Governor forwarded them to King with the despatch announcing his departure. Collins to King, 27 Jan., 1804.

2.—THE OCCUPATION OF THE TAMAR.

Possibly Governor King, if left to himself, would have been contented, at least for the time, with the establishment of the Colony at the Derwent as a sufficient safeguard against French designs. But the apprehensions of the Home Government had been thoroughly aroused by the Governor's despatches pressing the urgent necessity of occupying certain points in Bass Straits and Van Diemen's Land to prevent the probable intrusion of French claims to the territory. It was the consideration of these despatches which had led to the writing of the Minute of December, 1802, quoted in a former paper, and to the sending of Governor Collins to Port Phillip with instructions to place a post on King's Island also. The Cabinet, however, was not yet satisfied with the precautions taken, and six months later Lord Hobart addressed a despatch* (24th June, 1803, p. 429) to Governor King, in the following terms:— 24 June, 1803.

"It appears to be advisable that a part of the establishment now at Norfolk Island should be removed, together with a proportion of the settlers and convicts, to Port Dalrymple, the advantageous position of which, upon the *southern* coast of Van Diemen's Land, and near the *eastern* entrance of Bass' Streights, renders it, in a political view, peculiarly necessary that a settlement should be formed there, and as far as the reports of those who have visited that coast can be depended upon, it is strongly recommended by the nature of the soil and the goodness of the climate."

The despatch proceeded to designate Lieutenant-Colonel Wm. Paterson of the New South Wales Corps, Lieutenant-Governor under Governor King, as the Administrator of the new Colony, at a salary of £250 a year.

Lord Hobart's despatch was very perplexing to King. The direction to occupy Port Dalrymple was too positive to be disregarded, and yet the grotesquely inaccurate description of Port Dalrymple as on the *southern*† coast of Van Diemen's Land, and near the *eastern* entrance of Bass Straits, introduced an element of uncertainty that threw him into a difficulty as to his course of action. It was probable that Lord Hobart's directions were the result of a despatch of his own, dated 23rd November 1802, in which he had strongly urged a settlement at Storm Bay Passage, Port Phillip, or King's Island, to counteract any intention of the French intruding a claim within the limits of his government. But if so, it might be "respectfully presumed" that a mistake had been made in naming Port Dalrymple as on the south coast of Van Diemen's Land, and then the inference was that Storm Bay Passage was really intended. If this construction were right, then Colonel Collins's removal to the Derwent had anticipated the Minister's wishes. Furthermore, as Lord Hobart when writing had supposed Port Phillip to be already occupied by Collins, would his commands be best fulfilled by settling Port Dalrymple or re-settling Port Phillip? Or, if the despatch were literally obeyed, and Port Dalrymple occupied, would it not be advisable to send also a small post to Port Phillip or Western Port?

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* As an instance of the roundabout way in which even important Government Despatches reached the Colony in those days, it may be mentioned that Lord Hobart's despatch was landed at Norfolk Island by the *Adornis* whaler, and brought thence to Port Jackson by the *Alexander* whaler.

† It does not seem to have struck King that "southern" was probably merely a clerical error for "northern." In fact, this is the only possible explanation.

Opinion of Officers, 18 May, 1804.

The Governor propounded these questions to his principal officers, Lieutenant-Governor Colonel Paterson and Major Johnston of the New South Wales Corps, for their consideration and advice. They were unanimously of opinion that the commands of the Secretary of State to occupy Port Dalrymple, "with a political view," were too explicit and peremptory to admit of hesitation, and that they must be immediately carried into effect. They thought that the north side of the Straits should also be occupied, and a post established either at Port Phillip or Western Port, whichever might be found the more eligible situation. They recommended that Colonel Paterson should forthwith be despatched to Port Dalrymple with a small establishment, and a guard of not less than 20 soldiers.

King to Hobart, 15 May, 1804.

Having thus settled his course of action, the Governor lost no time in taking steps to send a force to occupy the post pending the transference of the colonists from Norfolk Island. The armed colonial cutter *Integrity*, 56 tons, was at once fitted for sea, and a small private vessel of 25 tons, called the *Contest*, was chartered to assist. The two ships were to take 20 convicts and a force of 34 soldiers, in all 56 persons. On the morning of the 7th June the New South Wales Corps was drawn up on the Government wharf as a guard of honor, and Lieutenant-Governor Paterson embarked in the pinnace to go on board his vessel. The pinnace left the

King to Hobart, 14 Aug., 1804.

Sydney Gazette, 10 June, 1804.

wharf, the battery fired a salute, and, to quote the reporter of the *Sydney Gazette*, "the most animated acclamations issued from the shore" as the new Lieutenant-Governor set out to found another British Colony—or rather to attempt to found it—for the same fate which befell the first attempt to found the Derwent Settlement attended that to the Tamar. It was now the depth of winter, and storms such as had driven back Lieutenant Bowen on his attempt to reach the Derwent just 12 months before met the ships at the entrance to Bass Straits. The *Integrity*, on rounding Cape Howe, battled in vain against the strong westerly winds which prevailed in the Straits, and had to put back to Port Jackson, which she reached on 21st June,* her passengers all ill in consequence of being battened down in the hold. The *Contest*, after beating about for a month, had to follow her consort's example. King was much disappointed, and made offers to the masters of two East India Company's ships then in harbour to take Paterson and his people to their destination, offers which their charter parties prevented them from accepting. There was therefore no alternative but to delay the expedition until the approach of spring, when H.M.S. *Buffalo* would be available for the service required.

King to Hobart, 14 Aug. 1804.

During the interval between the return of the *Integrity* and the departure of the *Buffalo* a question of some difficulty arose respecting Paterson's relations to the Lieut.-Governor at the Derwent. Colonel Collins claimed that his appointment as Lieut.-Governor extended to the whole of Van Diemen's Land, that the northern settlement was therefore within his jurisdiction, and Paterson under his command. This claim Paterson wholly repudiated. He contended that he had received an appointment from the King as Lieut.-Governor of Port Dalrymple at a time when Collins was supposed to be at Port Phillip, that consequently his command was *wholly* independent of Collins, and he absolutely refused to tolerate any interference by the Lieut.-Governor at the Derwent with him or his settlement. Governor King admitted the cogency of Paterson's argument, and issued a General Order dividing the island into two independent governments, to be known respectively as the Counties of Buckingham and Cornwall, the dividing line to be the 42nd parallel of south latitude, each government to be

Paterson to King, 27 Sept., 1804.

23 Sept., 1804.

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* Paterson in his despatch to Lord Camden, 14th November 1805, says he arrived in Port Jackson 17th June 1804, but this is probably an error.

subordinate only to himself as Governor-in-Chief of New South Wales and its dependencies.

Instructions to Paterson, 1 June, 1804.

Governor King's instructions to the new Lieut.-Governor present curious matter for study. We may pass over the usual directions as to the treatment of the aborigines, the investigation of the products of the country, the care of clothing, stores, and live stock, the oversight of the convicts, the regulations for the occupation of lands and their cultivation, religious worship, and so forth. But there are other features in the instructions which present a very striking contrast to what would in these days be thought proper to inculcate on the founder of a new colony. It must never be forgotten that these early establishments were not colonies at all in the modern sense, but military posts, established for political purposes, in which a limited number of convicts were utilised to provide the labour necessary for their maintenance. Instead, therefore, of encouraging trade and settlement, every possible precaution was taken to ensure the most complete isolation. This had the double object of keeping out foreign intruders and guarding against the escape of the convicts. Paterson was expressly enjoined to take particular care that all communication with the East India Company's possessions, with China, or with the islands visited by any European nation should be rigorously interdicted, or only allowed on the special authorisation of the Indian Government. No craft of any sort was to be built by any private person without a written licence from the Governor in Sydney. No intercourse was to be permitted between persons arriving in any vessel and the inhabitants of the settlement without the Lieut.-Governor's special permission. The American sealers who had given so much trouble to King had been building vessels from the wrecks of the *Sydney Cove* and other ships. These, if met with, were to be seized by putting the King's mark upon them. The introduction and sale of spirits by private persons was prohibited, and any which were introduced were to be seized and destroyed.

General order, 22 Sept., 1804. *Sydney Gazette*, 14 & 30 Sept., 1804.

By the end of September H.M.S. *Buffalo* was fitted and ready for sea. The armed tender *Lady Nelson* and the Colonial schooners *Francis* and *Integrity* were to accompany her, and assist in conveying the people and stores to the new colony. Paterson's establishment consisted of Dr. Jacob Mountgarrett (who had come up with Lt. Bowen in the *Ocean* on 24 Aug., and on leaving Risdon had received the appointment of Surgeon);

King to Hobart, 20 Dec., 1804.

King to Paterson, 11 Aug., 1804. King to Hobart, 20 Dec., 1804.

Mr. Alexr. Riley, Storekeeper, at a salary of 5*s*. per day; Capt. Anthony Fenn Kemp, Ensigns Hugh Piper and Anderson, 64 non-commissioned officers and privates of the N. S. Wales Corps, and 74 convicts. One settler, James Hill, accompanied the party, and possibly another. In all there were some 146 persons all told. The troops were embarked on Wednesday, 3rd October,—the music of the band, says our reporter of the *Sydney Gazette*, being "only interrupted by reiterated peals of acclamation from the spectators." On Sunday, October 14th, the Lieut.-Governor embarked from the Government wharf, under a salute of 11 guns from the battery, the band of the N. S. Wales Corps playing "God save the King" and "Rule Britannia." Governor King and a number of ladies and officers accompanied him on board the *Buffalo*, which saluted with 11 guns. The little squadron got clear of the Heads the next forenoon. The ships had a very rough voyage down, and a succession of heavy gales separated them. Most of the live stock died; and it was not until the 28th—a fortnight after leaving Port Jackson—that the *Buffalo* reached Eastern Cove, Kent's Group, where she found the *Francis*. Here she lay at anchor for 6 days, while it blew a strong gale from the westward. On the 3rd November the ships left their anchorage, and next morning the *Buffalo* made the entrance of Port Dalrymple. None of her consorts were in sight to try the channel for the larger vessel; and Captain Kent, with many misgivings, determined to make the venture; for he says, in his report to Governor King, "I saw little probability of the Settlement ever being formed unless some risk was run. I therefore bore up, in dark cloudy weather, blowing strong at north-west right on shore, for a harbour little—very little—known, hoping, should any accident happen to the ship, I might meet with every consideration for my zeal." After what he had heard of the strength of the tides, he was surprised to find it running only 1¼ miles per hour, and avers "that a common four-oared jolly-boat, rowed ill, could always, even in the height of the springs, head the tide between Green Island and Outer Cove, as it never exceeded 3 miles an hour." The night coming on, the ship came to an anchor below Green Island. It blew very hard in the night, and harder in the morning, the anchor came home and the ship drove on shore on the eastern shoals. Here she lay beating for three days; but the *Integrity*, Acting Lieut. Robbins, coming in, they lightened the ship of

Sydney Gazette.

Kent's Report, 28 Nov., 1804.

part of her cargo; and on the 4th day, after great exertions, she was got off, fortunately without damage, and came to an anchor in Outer Cove (George Town). Here the military, prisoners, and stores were landed, the tents were pitched, and on the 11th November possession was formally taken by hoisting H.M. Colours under a royal salute from the *Buffalo* and three volleys from the troops.

Paterson to Camden, 14 Nov., 1805.

Paterson to King, 23 Nov., 1804.

The other two ships did not arrive till the 21st, the *Lady Nelson* having suffered much damage from the storm, having had her decks swept, and having lost all her live stock. Before leaving, Captain Kent erected a flagstaff at Low Head, and other beacons for the guidance of vessels entering the port.

The day after taking possession (12th November), the camp was approached by a body of some 80 natives, under the lead of a chief. Presents were offered to the chief—a looking-glass, two handkerchiefs, and a tomahawk. Paterson says that the looking-glass puzzled them much, and that, like monkeys, on looking at it they put their hands behind it to feel if there was any one there. When they came to the boat they wanted to carry off everything they saw, but when made to understand that this could not be allowed they retired peaceably. Shortly afterwards, however, the blacks returned in greater force and made an attack on an outpost. A correspondent of the *Sydney Gazette* thus describes the incident:—"An interview took place with the natives, which began very amicably, but, unfortunately, their natural impetuosity has caused a temporary suspension of civilities, having attempted to throw a sergeant from a rock into the sea, and attacked his guard of two men, which compelled them to fire in their own defence." One black was killed, and another wounded in this affray.

Ibid.

16 Dec., 1804.

The hurried landing at Outer Cove was necessitated by the accident to the *Buffalo*, and the pressing need of immediately unloading her. As there was a sufficient stream of water for present use, and about 100 acres of land that might do for cultivation, Paterson thought it best to keep his people at the spot where they had landed until he should have had time to explore the river. Captain Kemp, Dr. Mountgarrett, and Mr. Reilly, the storekeeper, were appointed the first magistrates of the settlement, Dr. Mountgarrett acting as Superintendent of Public Works. Mr. Thos. Massey was made chief constable, with three subordinates; two overseers were appointed, and Jas. Hill, the solitary settler, was

Paterson to King, 26 Nov., 1804.

General order, 19 Nov. 1804.

put in charge of the live stock. His duties were not onerous, for only a horse, four head of cattle, three sheep, and 15 swine had survived the storms of the passage. There was no chaplain, and as Paterson was at a loss for a person to perform Divine service, he induced Captain Kent to discharge from the *Buffalo* a Mr. Edward Main, who, we may presume, had some qualifications for the office, and who was thereupon installed to attend to the spiritual wants of the little community. The prisoners were set to work to erect temporary huts for themselves, which were placed clear of the camp on the opposite side of the creek, to prevent as far as possible communication with the troops. The prisoners worked hard and cheerfully from daylight to dark every day, and in a fortnight from the time of landing the huts were completed.

Paterson to King, 26 Nov., 1804.

The Governor's next care was to begin cultivation, for, with a salt meat diet, a plentiful supply of vegetables was most important to the health of his people. A gang of men was therefore set to work to break up ground. The means at hand for cultivation were limited; hardly any agricultural implements had been provided. The seeds had nearly all been destroyed by rats on the passage down, and most of the plants sent had died, though a few fruit trees and strawberry and hop plants had been saved. The Governor had to buy potatoes for seed from the master of the *Integrity*, as the authorities had not thought it worth while to send any for the use of the colony. Paterson's despatches show that in fitting out the expedition there had been the same extraordinary want of care and foresight in providing necessary things which seems to have been characteristic of official preparations for all these early settlements. He complains to Governor King that the prisoners were wholly destitute of shoes, and that he had been compelled to ask the purser of the *Buffalo* to let him have 100 pairs from the vessel's stock; while in such a vital matter as the supply of provisions, the quantity sent was so inadequate, in view of the difficulty and uncertainty of obtaining timely aid from head quarters, that he had thought it necessary to supplement his stock with salt meat from the *Buffalo's* stores.

Ibid.

The Lieut.-Governor had already made some short excursions from Outer Cove, and Captain Kent, of the *Buffalo*, had examined Western Arm, where he had found good streams of water, land fit for cultivation, and good timber; and from his report Paterson thought that it appeared to be the most eligible situation for the seat of government. It had taken him three weeks to get his people fairly settled at Outer Cove, and he was now free to go up the river and thoroughly examine the country. On the 28th November, therefore, he went on board the *Lady Nelson*. He took with him Surgeon Mountgarrett; with Ensign Piper, and a corporal and 3 privates of the N. S. Wales Corps, as a guard. They ascended the river, making observations of the country and soil as they went, till they arrived at the junction of the two rivers forming the present port of Launceston; and here the vessel came to anchor. Paterson was greatly pleased with the park-like country on the present site of Launceston, and considered it better pasture land than the Seven Hills, near Parramatta. The party now proceeded up the main river (now North Esk) in the ship's boat and the Governor's wherry. The journal notes the rich plains on the river banks; and further on (near St. Leonard's) the beautiful rising ground to the left, the green hills covered to the top with trees, and on the other side of the river—which was about 20 yards wide—the plain with stately gums, great wattles 60 to 80 feet high, and dense scrub. They pushed on with difficulty, the river being blocked with drift-wood and fallen trees, and various rapids giving them much trouble, until they reached a point—apparently about the White Hills—above which they found it impossible to take the boat. Here they pitched their tent on a rising ground, and looked with delight over the rich plains, or rather meadows, covered with luxuriant herbs and pasture, and waiting for the plough. Paterson says, "From my tent there is an extent which is seen in one view of nearly three miles in length and at places one in breadth, along the banks of the river, where thousands of acres may be ploughed without falling a tree. These plains extend upwards of 10 miles along the winding banks, and everywhere equally fertile." He found good clay for bricks, abundant timber for building, reeds for thatching, with everything necessary for agricultural settlement, and considered the country superior to any yet discovered. They made excursions on foot some miles further up the river; and then, "having ascertained to a certainty that the country in general can hardly be equalled either for agricultural or pasture land," they made their way back down the river, and reached the *Lady Nelson* near the Cataract, after an absence of four days. Paterson describes the Cataract Gorge, with its stupendous

Paterson's Journal, 506.

Ibid., 515.

columns of basalt rising one above another to over 500 feet in height, as picturesque beyond description,—the effect being heightened by the number of black swans, unable to fly, in the smooth water close to the fall. Paterson named the Cataract River the South Esk; and, to the main river, including what is now known as the North Esk, he gave the name of the Tamar, out of compliment to Governor King, whose birthplace was on the English stream of that name. After an absence of a fortnight, the *Lady Nelson* got back to Western Arm, and entered that shallow inlet. Here Paterson landed to examine, for the second time, a piece of land at the head of the Arm, between two streams a quarter of a mile apart, and which he had named Kent's Burn and M'Millan's Burn. He says, "On landing, the soil is very forbidding, being a hard whitish clay mixed with quartz; but towards the hills there are patches of excellent ground, and the finest timber I ever saw (gum and wattle). Boats, at high water, can come up close to either of the runs. After much labour and attention I have paid in examining every part of the river, I have seen none so advantageously situated for a permanent settlement as this, where there is an easy communication with vessels arriving in this port as well as with settlements higher up the river. These favourable circumstances have induced me to determine upon removing the principal part of my small military force, with most of the prisoners, and commence clearing ground and erecting the necessary buildings before the winter sets in."

Paterson's Journal, 525.

The question naturally arises, by what extraordinary perversity of reasoning did Paterson arrive at the conclusion that the miserable patch of land at the head of Western Arm was pre-eminently the best place for his chief settlement? He had just come back from a visit to the splendid site of Launceston and the fertile banks of the North Esk, which he described as superior to any country yet discovered either in Van Diemen's Land or New South Wales, and as possessing every possible advantage for a settlement, including approach to it by a fine river navigable for large ships. What induced him, then, after anxious thought, to pass this by, and deliberately make choice of a narrow strip of land which he describes as having a forbidding soil, and which was situated at the head of a shallow and muddy inlet not accessible even to boats except at high water? The explanation, I think, is to be found in the policy of the home government. Founding a colony, according to modern ideas, means to open up the country as speedily as possible, to settle the lands with energetic cultivators who will develop the natural resources of the soil, to attract a population who will thrive themselves and advance the colony by the extension of an export trade. Nothing was further from the thoughts of the home authorities than any plan for colonising in this sense. New Holland was to be, not a colony, but a place for the reception of criminals,—a settlement to relieve the home country of the ever growing and overwhelming difficulty of disposing of her criminal population. The British Government not only did not encourage colonisation, they endeavoured as far as possible to prevent it, or at least to confine it within the narrowest limits, permitting it only in so far as it might be made to serve as an auxiliary to their sole object—the maintenance of a penal settlement at the smallest possible cost. The subordinate establishments at Port Phillip, the Derwent, Port Dalrymple, Newcastle, and other places were planted in the first instance as military posts, to prevent France establishing herself in spots where she might be able to harrass the great penal establishment at Port Jackson. The expeditions of Bowen, of Collins, and of Paterson were mainly precautionary measures, part of the military policy of England in her great struggle with France. Prisoners were a useful part of these early establishments, as providing labour which, by the erecting of buildings and cultivation of the soil, might make these posts as little burdensome as possible to the national exchequer. These outlying settlements, also, if favourably situated, might in course of time become valuable penal stations. Some of them, such as the Derwent and Port Dalrymple, would further serve the useful purpose of ports of refuge for the East India Company's vessels in the China trade, and form convenient posts for the protection of the whale and seal fisheries from American and other foreign intruders.

Bowen's choice of Risdon, and Collins' abandonment of Port Phillip when he could not find a suitable locality near the Heads, were not, as is too often supposed, the result of incapacity and blindness. They wanted to form a station, not to plant a colony—a station readily accessible from the sea—and the resources of the interior of the country were of little concern to them, so long as they could find in their immediate neighbourhood sufficient pasture for their cattle, and enough agricultural land to yield a food supply for their people. It was, doubtless, considerations such as these which led Paterson deliberately to turn away from the fertile banks of the North Esk and fix his people on the little strip of forbidding soil at the head of Western Arm.

Paterson to King, 27 Dec., 1804.

The Lieut.-Governor gave the name of York Town to the spot he had chosen for his town. He marked out the ground for erecting dwellings, and set the prisoners to work to load the *Lady Nelson* and *Francis* with a portion of the stores and with two wooden houses which he had brought with him from Port Jackson. He detained the *Lady Nelson* until after the new year in order to assist in the removal from Outer Cove, and when she sailed for Port Jackson on the 11th January, 1805, she took some tons of the iron ore which he had found in great abundance in the neighbourhood of his settlement.

Sydney Gazette.

From this point it is difficult to trace the history of York Town from the official papers. Paterson's despatches present a great contrast to the careful and voluminous reports sent by Governor Collins from the Derwent. Collins could give interest even to an official document, and introduced into his despatches an amount of graphic detail which not only gives us a full history of events but enables us to reconstruct the actual condition of his colony. Paterson was neither so precise nor so picturesque as Collins; his official communications are meagre, and his carelessness in supplying regular and full returns brought upon him the censure of Governor Bligh. The Lieut.-Governor's deficiencies can, however, be partly supplied from the columns of the *Sydney Gazette*, which, during the year 1805, contained many letters giving information with regard to the new settlement at Port Dalrymple.

Sydney Gazette, 10 Mar., 1805.

In January or early in February, 1805, the schooner *Integrity* was despatched by Governor King to examine a port situated to the westward of the mouth of the Tamar—presumably Port Sorell—which had been discovered by Surgeon Mountgarrett and Ensign Piper, and by them named Supply River. On the 22nd she left, carrying a report that the country between the Supply River and York Town had been found so good that it was intended to give the first free settlers locations of land in that district. The buildings at York Town were rapidly approaching completion. The colony at Outer Cove was doing well, the gardens had flourished, and on the 18th January—ten weeks after the first landing—the Governor and others who had cultivated small plots of ground had peas, French beans, potatoes, and turnips. Vegetables were plentiful, and it was fully expected that the cultivation of grain would be an equal success. Towards the end of March, H.M.S. *Buffalo* again sailed for the Tamar, carrying an additional military force, 50 prisoners—mostly from Norfolk Island—2 horses, 8 head of cattle, 135 sheep, and a quantity of stores. This made the total strength about 200 persons. Mrs. Paterson was a passenger by the *Buffalo*, and the transference of head-quarters to York Town was completed before the end of March.

Sydney Gazette, 24 Mar., 1805.

Paterson to King, 5 April, 1805.

By this time Paterson had received a welcome addition to his resources. Lord Hobart had, in 1803, directed Governor King to enter into an arrangement with Campbell & Co. of Sydney, to import cattle from India for the use of Collins's Port Phillip settlement. When Collins removed to the Derwent, King arranged with Campbell & Co. to supply these cattle to one or other of the Van Diemen's Land settlements. The directions as to the their final destination were given in a way sufficiently curious, and which illustrates the primitive methods in use in those early days. The master of the vessel bringing the stock, on his arrival at the entrance of Bass Strait, was to send a boat ashore at Sea Elephant Bay, King's Island, where he would find a shed, from the rafters of which a bottle would be suspended, and in the bottle he would find a letter with the Governor's directions as to the port at which the cattle were to be landed. The contract price was to be £25 per head for the cows landed, and £5 per head for the calves. 910 cows were put on board the ship *Sydney* at Calcutta. Of these 298 died on the passage; the remaining 612, with 10 calves, being safely landed at Port Dalrymple at the end of March. The cost to the Imperial Government of this shipment was £15,350.

Campbell to King, 19 May, 1804.

King to Camden, 30 April, 1805.

As York Town did not afford sufficient pasture for the stock, the Lieutenant-Governor had them landed at Outer Cove, where Ensign Piper was placed in charge of them. The change of climate and food, however, was so injurious to them that their numbers rapidly diminished, and they were removed to the less exposed western shore, where sheds were erected for their shelter. In spite of all care and the labour of a large number of men in providing them with fodder, the winter reduced them so much that the return of spring saw only 251 of the Bengal cows surviving. Paterson therefore had them removed, first to Point Rapid and then to the

Paterson to King, 14 Nov., 1805.

Ibid., 30 Dec., 1805.

plains on the North Esk, where they found better pasture and a more congenial climate. Although York Town was now the head quarters, Paterson still kept up an establishment at Outer Cove as his port and his depôt for stock. He also had a small post at the Low Head flagstaff and at Green Island, which formed his store depôt. This did not meet with the approval of the Governor at Sydney, who objected to the division of his forces, and thought they ought to be concentrated at his principal settlement.

Paterson's Journal, 528.

There is little more to tell respecting the York Town Settlement. After a few months' trial Paterson found the site so unsuitable that in March 1806, he moved his head-quarters to the banks of the North Esk—the present site of Launceston. A small establishment was, however, maintained in the old port for upwards of a year longer, and then York Town was finally abandoned.

For long years afterwards the whole district was deserted, save for a few scattered and insignificant holdings. Towards the year 1870 (I think) attention was directed to the working of the rich iron deposits in the neighbourhood of Western Arm, and large smelting works were erected at Ilfracombe. The enterprise proved a failure.

Though the iron industry had failed, gold was destined to restore the fortunes of the district. Gold was discovered in 1870 at Cabbage-tree Hill, in the vicinity of Middle Arm, and by the development of the Tasmania Mine a considerable population has been attracted, so that in the present year we have the town of Beaconsfield a prosperous mining centre, claiming to be the third town in the Colony, within less than five miles of the spot which Lieutenant-Governor Paterson designed to make the capital of northern Tasmania.

Anyone who has the curiosity to see the ruins of this early settlement may easily reach the spot from Beaconsfield. A rough bush-track, practicable for a chaise cart, winds in a north-westerly direction through miserably poor country, covered with gum forest and a heath-like scrub intermingled with the dwarf grass-tree. After travelling for about 5 miles along this track and crossing the Anderson's Creek of Paterson, we reach M'Millan's Burn, now known as Massey's Creek, and emerge from the bush. Between this creek and a creek on the north, (called by Paterson Kent's Burn, but now known as the York Town Rivulet), just at the head of the Western

Arm, is a cleared flat of indifferent land, 300 to 400 yards wide. This is the site of Paterson's settlement. On the banks of the northern creek are some fair grass paddocks; and immediately beyond rises an abrupt, almost precipitous, wooded ridge, to which Paterson gave the name of Mount Albany. From the side of this hill the flat on which York Town stood lies spread out below us. Two little wooden cottages or huts, surrounded by neglected orchards, are the only habitations. To the left stretch the shallow waters of Western Arm, fringed with extensive mud-flats which are bare at low water. The owner of one of the huts on the desolate clearing is an old man, the son of a man who came with Paterson's first establishment. He is ready to tell the visitor of blacks and bushrangers, and of the days when there was a Government House, and York Town was busy with soldiers and prisoners.

Ruins of the original Settlement there are none. The old inhabitant points to a hole, from which the foundations have been long ago removed, as the site of Government House, and to a clump of wattles as the spot where once stood Captain Kemp's house, the birthplace of the late Mr. George A. Kemp. This is all;—except that back in the bush, where the little valley widens, are a few mounds under the gum-trees, half hidden by the low scrub, and indicating neglected and forgotten graves.

REMARKS ON A RECENT PROPOSAL TO INTRODUCE OSTRICHES INTO TASMANIA.

By Jas. Andrew.

During last year a proposal was made to the Government to introduce Ostriches into Tasmania, following the example of what was done with some little success in the Continental Colonies of Australia and in New Zealand at a time when very large profits were made out of this industry in the Cape Colony and other South African States. The offer, however, was made subject to the financial safeguard of a Government guarantee, and failed to secure favourable consideration.

From observations of the habits of wild ostriches, and from some little experience of their management when domesticated, having owned birds myself, I venture to offer a few remarks on farming for feathers, and the possibility of such an industry being successfully carried out in Tasmania.

An observer of ostriches in their native state would imagine the task of bringing such birds under the subjection of man to be almost an impossibility. No wild creature of the plains is so difficult to approach, none are so timid or so fleet. The stratagems of natives or the well organised arrangements of professional hunters are required to ensure a successful chase. And yet their domestication has been comparatively easy, and now that their habits are well understood it is found that in confinement they can be bred and reared, and maintained as adult birds, with no appreciable loss of their natural characteristics.

Their chosen home is a waterless desert, with sparse and stunted vegetation, affording no shelter from the burning sun; their food small reptiles and animals, the young leaves and twigs of bushes, and the wiry grass and other small plants whose existence under such surroundings is always a mystery to travellers. The speed of the ostrich is a marvel of pace. Each stride, as has been verified by careful measurements, is from 22ft. to 28ft. One observer reports 30 strides of 12ft. each in ten seconds, or 26 miles per hour, which agrees with the estimate formed by Dr. Livingstone.

The male bird is an imposing creature, in height to the top of the head often 9ft. and even sometimes 10ft., thus exceeding any other existing species of aves. The neck is long and muscular, the head small, with a broad and depressed bill, eyes large and brilliant. The wings are hardly more than rudimentary, being useless for purposes of flight, the thighs are exceedingly well developed, and are destitute of feathers, the legs and feet massive, the toes, two only in number, of unequal length. The body feathers in the male are deep black, the wing flights and tail feathers are, in strong contrast, pure white. The plumage of the female is a uniform brownish grey, but specimens are not infrequently met with having white wing and tail plumes, and I have seen domesticated birds of both sexes with spangled black or brown and white body feathers.

A peculiarity of an ostrich feather is that the quill is exactly in the centre of the webs instead of, as in the plumage of all other birds, more on one side than the other. This is accepted as the origin of their use as an emblem of justice in Egyptian hieroglyphics.

It appears that the geographical distribution of the ostrich was formerly much greater than at the present time, although even now its range is more extended than is generally supposed, including some parts of Asia, Arabia, and Northern and Southern Africa.

In a condition of nature ostriches are polygamous, and their nests, mere shallow depressions in the soil, are resorted to by several members of the same family, and in consequence the eggs they contain, laid at very varying intervals, are to be found at all stages of incubation. Contrary to a generally accepted belief the sun's rays are not depended upon to hatch out the chicks, the birds of both sexes taking turns of duty on the eggs. The hen bird lays every other day until some twenty or more are in the nest. The period of incubation is 42 days. The eggs are from 5 inches to 6 inches long, and 4 to 5 inches broad, weighing between 3 and 4 lbs., or of about 24 times the capacity of those of the common fowl; they vary in appearance in different countries, some being pitted all over with small dark coloured spots, others are a smooth creamy white, without blemish of any description, and resemble polished ivory. As an article of diet they are often of the greatest service, a large one, according to one writer, is said to furnish a meal for ten men. Hunters cook them in the shells placed on the embers of the camp fire, a hole knocked in the upper end, and the contents briskly beaten up with a forked stick during the operation. In puddings and custards they are frequently used by Ostrich farmers, and in this condition, as well as in the more primitive form, I have frequently had occasion to commend them as a welcome change in a very limited bill of fare. The shells, about 1/16th in. thick, are almost indispensable to the Bushmen of the Kalahari desert, for, filled with water, stores of them are buried for use on their return journeys from hunting expeditions or marauding forays, whilst pursuing parties, being unable to carry a sufficient supply, are unable to continue the chase.

Threaded on stout wire by which goods are suspended from the beams of store-houses, empty shells are an efficient precaution against injury by rats.

Prior to 1864, when modern experimental domestication commenced, the high prices ruling for feathers led to the indiscriminate slaughter of ostriches. In easily accessible districts they were soon exterminated, and there was occasion to fear that these interesting and valuable birds would soon become as extinct as their near connection, the Moa of New Zealand, and the enormous Æpyornis of Madagascar. But man's ingenuity and perseverance have counteracted the evil effects of his previous greed and destructiveness, and there is now no danger of so deplorable an event.

The author of the "Dominion of Man" shows that the settlers of South Africa are not the first Ostrich farmers, for in this, as in other instances, we find that the ancient Egyptians have been our predecessors. He states:—"On the monuments there are representations of ostriches which are under the dominion of man, and which are being handled in a manner which shows a thorough acquaintance with the character of the bird."

Rather less than thirty years ago the first attempt was made in the Cape Colony to keep ostriches in confinement with a view to profit. The feasibility of rearing their chickens artificially was soon demonstrated; the value of the new industry required no advertising; imitators of the original experimenters were numerous, and in a few years Ostrich farming was a firmly established resource of the Cape pastoralists. It was not necessary, however, to be a large landholder to commence operations, for breeding birds are always kept separate from the flock, each pair being enclosed in a camp or paddock of convenient size, varying in extent from five to forty acres, and chosen in a level locality, free from rocks, stumps, and holes. With rare exceptions domesticated birds are monogamous, but some difficulty often arises in inducing them to mate according to the desire of their owners. The hens are sometimes most capricious in their choice, whilst the males display absolute brutality towards unappreciated companions, and many changes are occasionally found necessary before satisfactory arrangements can be concluded. The breeding camps are enclosed by stone walls, thorn brush, or more frequently wire fences; and where a number of enclosures are together, the dividing fences must be double, with a space between of not less than 6ft. or 7ft., to prevent the male birds from fighting. A very slight enclosure suffices to confine ostriches at ordinary times, for they cannot step over a fence a yard high, but when frightened or enraged they rush blindly at any obstacle, and in consequence all enclosures must be secure.

During the nesting season the male is most pugnacious and may only be approached in safety with great precaution. He resents the intrusion of any visitors on his domain and proves a most formidable opponent. His mode of attack is by a series of kicks. The leg is thrown forwards and outwards until the foot, armed with a most formidable nail, is high in the air, it is then brought down with terrific force, serious enough to the unhappy human being or animal struck with the flat of the foot but much worse if caught and ripped by the toe. Instances are known of men being killed outright by a single kick, and I remember, whilst on a visit in the neighbourhood, that on a farm near Graaff Reinet a horse's back was broken by one such blow aimed at its rider. If attacked a man should never seek safety in flight; a few yards and the bird is within striking distance and the worst consequences may result. The alternative is to lie flat on the ground and submit with as much resignation as possible to the inevitable and severe pummelling which it may be expected will be repeated at intervals until a means of escape presents itself, or the bird affords an opportunity of being caught by the neck, which if tightly held and kept down prevents much further mischief. Under such circumstances, however, I have known a bird with a badly calculated kick strike the back of its own head scattering the brains, a serious loss of valuable property to the farmer. It is, of course, an easy matter to break a bird's neck when in the position described, but at the time to which I refer the high price of birds prohibited such a mode of relief except under the most exceptionally dangerous circumstances. The early practice amongst farmers was to enter the camps protected with a long pole forked at the end. As the bird advanced his neck was received in the fork and his feet kept beyond striking distance; but as they soon learned to suddenly back out of the prongs and before a fresh defence could be arranged to rush the intruder, it has been the custom more recently to carry a small thorn bush at the end of a long staff, which, always kept at the level of the bird's eyes, proves a tolerably efficient protection. It is usual for two men to enter a camp together when any work has to be performed, one to act as guard.

Confined in such small enclosures ostriches require, of course, some artificial food; this generally consists of mealies, or Indian corn, and often the leaves of the prickly pear chopped into pieces. They are also furnished with a supply of pounded bones. It is usual to keep drinking water in the camps, but as to whether this is necessary opinions differ. Birds have been deprived of water for nine months, whilst those in an adjoining enclosure had an unlimited quantity, but there was no apparent difference in their condition or health.

As a first step towards domestic duty the male bird, in confinement, scratches out a shallow depression in the ground, generally in some such unsuitable spot as the dry bed of an occasional water-course. The eggs vary to some extent in number, and on farms where natural nesting is preferred all over about twenty are removed.

There has been much difference of opinion as to the rival merits of leaving this process of hatching to the birds or saving them the duty by the use of incubators, but I am inclined to support the view that a larger percentage of chickens and stronger birds are secured by the former method. It is essential, however, that an incubator should be amongst the appliances of every ostrich farm for use in emergencies.

As in the wild state, the male performs an equal share of incubation with the female, who, being less conspicuous than her consort, remains on the eggs for the greater part of the day, the male sitting during the night, his turn of duty lasting from about four p.m. until early the next morning. At the proper hour the male grazes in the direction of the nest in an apparently indifferent manner until the hen, suddenly rising, runs some distance at a rapid pace, frequently changing her direction. At once he is on the eggs, and almost concealed, she having momentarily attracted the attention of onlookers. Much care is exercised by ostriches to conceal their nests, and it is surprising how inconspicuous the birds are when, surrounded by the low bushes of the veldt, they crouch over the eggs with their long necks extended on the ground.

It is not uncommon for one of the birds to refuse further duty at any stage of the hatching process, when the other, either male or female, may remain faithful to its instincts and, unaided, patiently complete the necessary period. The vitality of the embryo chick is remarkable. In my own experience I have in the early morning taken home eggs which had been exposed all night to a severe frost, and afterwards succeeded in hatching them in a box before the fire.

During natural incubation the eggs are liable to destruction by the many enemies of the ostrich, as are also the young birds for some time after hatching. Jackalls, baboons, hawks, and crows attack either eggs or chicks, whilst should an adult bird resent the appearance of a porcupine in its camp, it may be lamed for life by kicking against so efficiently armed an animal. It is no fiction that crows, unable to break and feast on the eggs by other means, pick up stones with their feet, and hovering perpendicularly over the nests, drop their missiles with destructive effect. They destroy tortoises in a somewhat similar manner: the reptile is itself raised into the air—a rock the target. What truth there may be in the assertion that a crow so encumbered cannot fly horizontally, I am unable to say, but there can be no reason to doubt the many authorities who vouch for the above.

The young birds are at first about the size of domestic fowls, but in their markings resemble young partridges, with the peculiarity of having what appear like small porcupine quills mixed with the down on their bodies. If hatched naturally they must be removed from the camps within ten or fourteen days or they are liable to acquire wild habits prejudicial to discipline in their future artificial state of existence. For the first month or two the chicksare exceedingly susceptible to changes of temperature, they are carefully watched by day by the boy in charge (any male native of whatever age is a "boy") and they soon learn to know and respond to his warning cry. They are easily frightened, and at any alarm scatter in all directions, and after running a short distance, crouch, neck extended, on the ground, and so resemble their surroundings that an inexperienced eye might easily fail to detect them even if right in their midst. Dogs, from their liability to cause a panic amongst youngsters and annoyance to older birds, should never be seen on an ostrich farm. At night the chickens are housed in warm flannel-lined boxes placed in an artificially heated room. For a day or two after first seeing light they require little or no food, but make preparation for the serious business of life by taking in a supply of small pebbles to assist the digestive action of the gizzard. Their first sustenance consists almost exclusively of soft green stuff chopped into pieces of convenient size. Lucerne, rape, cabbages, etc., are the usual diet, with later, a liberal supplies of mealies (Indian corn), or they may be successfully reared on veldt which has been kept clear from other stock. At all times, however, young ostriches must be kept away from the plants of wild tobacco, which, if eaten, invariably prove fatal to them. The birds grow rapidly and in a month are as large as turkeys, and the down has disappeared, being replaced with rudimentary feathers. At six months old they require comparatively little attention, the head of the bird will now be as high as an ordinary man, and in a year nearly the full size is attained and the first crop of feathers is fully ready for cutting. A most amusing peculiarity of young birds is a tendency when let out from the kraal in the morning to dance wildly and rapidly in a circle, neck extended and wings opened, at first revolving slowly, afterwards with increasing pace until they gyrate in a most astonishing manner. Although adults in size at this age it is not for another two years or more that their reproductive instinct appears to be developed.

Feather cutting is presumably the most important operation on a farm. The process is by no means cruel, and entails far more discomfort to the men employed than to the birds themselves. A small yard or enclosure is so closely packed with ostriches that they are quite unable to move and their only means of defence, by kicking, is prevented. A man can then go amongst them with impunity, and spreading in turn the wings of each bird with a small pair of self-opening garden nippers, he severs the quills of two or three feathers at a time, passing the plumes as cut to his assistant. The first row of the wing flights of the male bird, about 24 in number, are pure white, as also are the second and sometimes the third rows, but those with grey or brown edges are remarkably handsome, and all, even the small body feathers, are marketable. After being some time in the yards the birds becoming used to their surroundings peck persistently at any shining object, and frequently at the ears of the operators: all studs, bright metal buttons, etc., should be removed before commencing such work. One peck is a trifling circumstance, but many repetitions of it on the same spot occasion considerable pain: sore ears for some time afterwards has invariably been my experience after a day in the yards. In addition to this the birds swarm with vermin, which does not enhance the pleasure of the work. Sometimes it may be found impossible to get a male bird of savage disposition into the clipping pen, and then, and then only, is the practice of pulling the feathers resorted to, for he must be caught and held whenever a favourable opportunity presents itself. He may perhaps expose his neck to be seized and held fast over a fence, a second man can now approach from behind and pluck the feathers, returning to a place of safety with as much expedition as possible.

Most of the profit made in the earlier days of ostrich breeding was by the sale of young birds for stocking other farms. The prices realised were astonishing, and well paired mature birds could hardly be purchased except at prohibitory rates. In 1881 chickens, as soon as hatched, sold for £5 a-piece; at three months old, for £10; and at 12 months, for £20 or £30. At one sale thirteen lots of mated birds, some of which had commenced laying, realised from £125 to £220 per pair. These were from six to eighteen years of age. One exceptionally prolific pair were considered by their owner to have been worth quite £400 a year to him for several years in succession; for they reared four broods of chickens in thirteen months, all of which found a ready market at £10 per head. Feathers, of course, vary in value exceedingly, according to quality, and are subject to great fluctuations in price. In the halcyon days of this description of farming the best blood feathers, of which about 120 weigh 1lb., were worth from £40 to £60 per lb., or more than their weight in gold, and a domesticated adult bird yielded each year a crop worth nearly £20.

A peculiar blemish is often observed in ostrich feathers procured from tame birds, which is known as the "hunger streak." It appears, according to the authors of "Ostriches and Ostrich farming," as a line of imperfection across the web of each feather, chiefly in those of the wings, while on the shaft the mark may not only be seen but felt as a slightly projecting ridge. The injury from this cause is sometimes such as to occasion the feathers to break off." "It occurs most frequently in time of drought, when the birds are unable to procure their natural diet, and have to be fed on maize, or such other dry food as is most easily obtainable. This produces an unhealthy condition of skin, and experience has shown that the remedy lies in the cultivation of prickly confrey, which not only withstands droughts well, but furnishes the birds with excellent food well suited to their requirements.

Feathers require no preparation for sale except washing and careful classification. Of the different grades sorted for the London market those from wild birds rank first, then white tame feathers, the best only worth half as much as prime specimens of the former, followed by others known as feminas, byoks, boos, blacks, etc.

To preserve wild feathers from risk of injury, hunters and traders, during their rough and prolonged journeys in the interior of South Africa, used at one time to insert each valuable plume into a hollow reed. The end of the quill was first introduced, and by repeated tapping the whole feather gradually disappeared, the webs lying upright alongside the shaft. With the ends of such reeds securely sealed no harm could result.

There were only 80 tame ostriches in the Cape Colony in 1865, and the feathers exported weighed 17,522lbs., valued at £65,736, the whole of which, except 120lbs., were from wild birds. In 1875 the number domesticated was no less than 32,247, and the exports were valued at £304,933 for 49,969lbs. In 1882 exports reached the highest value they have ever yet attained, viz.: £1,093,989 for 253,954lbs., and since 1886, when the export was 288,568, valued only at £546,230, the yield has steadily decreased. The number of domesticated ostriches in the colony is now about 160,000. In twenty years the average price for all South African exports of feathers has fluctuated from 70s. to 110s. per lb.

It is evident, then, that the supply has exceeded the demand, the enormous profits made by the sale of young birds will never more be realised, and it is hardly to be expected that feathers will ever again be quoted at the old market rates. But there should still be substantial recompense to be earned in the country where they are indigenous by an ostrich farmer managing his property with skill and intelligence, and in spite of a certain amount of risk attached to the industry, it should be equally as attractive as sheep farming. The danger of allowing the free removal of birds and eggs to other countries was long ago recognised by the Government of the Cape Colony, for, in 1883, they imposed an export duty of £100 on every bird, and £5 on each egg. Before this, however, several shipments of ostriches had been forwarded to India, California, the River Plate district, and to the Australian Colonies, and it has been made evident that feather farming may be followed with some amount of success in all these countries. In fact any land with a dry and temperate climate, having level wastes, may be found suitable for this industry.

Tasmania, however, is less adapted for the purpose than any of the neighbouring continental colonies, or than parts of New Zealand. Wooded, hilly or uneven country is quite unfitted for farming ostriches and grassy plains are found to furnish an insufficient variety in diet. Climate has also to be taken into consideration and even in the dry Wimmera district of Victoria rheumatism and cold have proved very destructive amongst the birds kept there.

Further, the statistics of Australasia offer little encouragement to introduce ostriches here. In South Australia, where they have been kept for many years, the total number of birds is, at the present time, only 725. In Victoria, where it is nearly 20 years since Sir Samuel Wilson carried out experiments at Longernong the increase is insignificant, and in New South Wales and New Zealand there are only small flocks.

But more cogent reasons still for deprecating their acclimatisation in Tasmania are to be found in the existing state of the industry in South Africa, where full-grown birds can now be purchased for from £3 to £4 each, or about the value of their feathers at the current rates. Strayed birds, barely worth the trouble and expense of recovery, become in certain districts a cause of much annoyance and even danger to persons travelling, so that it is considered unsafe to go out except when armed with a gun, and the state of affairs has been found sufficiently important to warrant the appointment of a select committee of the House of Assembly in the Cape Colony, who in their report dated 4th July, 1889, recommended the repeal of the Acts of 1870 and 1875, which imposed severe penalties for interference with wild birds or their eggs, and advocated perfect freedom for their destruction on private property and liberty to anyone to shoot them on Crown Land on payment of £5 for a license.

NOTES ON A RECENT DREDGING TRIP IN THE DERWENT.

By A. Morton, F.L.S.

The Tasmanian Fisheries Commissioners having decided to examine the several bays in the river Derwent, for the purpose of ascertaining whether, as in former times, there still existed natural oyster beds, advantage was taken of the opportunity to pay special attention to the marine fauna that might be obtained by the means of the dredge. Mr. A. Durrand, F.R.M.A., a gentlemen on a visit to Tasmania, who has made a collection of Foraminifera from many parts of the southern seas, accompanied us on our trip.

Several bays to the northward of the harbour were tried, but the dredge failed to secure any specimens of oysters, and in only one or two instances did we obtain any dead shells. Although from a commercial point of view the result of the dredging trip proved comparatively a failure, still from a scientific point we were amply rewarded. Instead of finding the Oyster, a large quantity of Pectens or Scallops were obtained. *Pecten meridonalis, P. bifrons, and P. asperrimus.* As has already been pointed out by Mr. Seager, the Secretary to the Fisheries Commission, a large number of this shell fish can be obtained in the river Derwent by means of the dredge, the quality being equal to the European Scallops, it is to be hoped that steps will be taken by our fishermen to place in the market this class of shell fish that should readily find consumers. As the places we dredged in were rather far up the river, the number of species of Mollusca were naturally limited, those obtained belonging to the genus Cardium, Fusus, Triton, Elenchus, and a few others well-known. A large number of a pretty shell known as *Modiolaria Cumingiana*, Dunker, were met with, inhabiting the sponge, and embedded in the larger kind of Ascidians. This shell is common in the Australian waters and also in New Caledonia. Several Crustaceans, chiefly of the smaller kind, were obtained, one kind being found in great numbers inhabiting the common Mussel. This peculiar little Crab, belonging to the genus *Pinnotheridæ Pinnotheres pisium*, Leach, I find has a very wide range common in the European seas, and although found inhabiting the Mussel of New Zealand, has not yet, I am informed by Mr. Thos. Whitelegge, the able Zoologist of the Australian Museum, Sydney, been observed in the Mussel found round the New South Wales coast.

Professor Hutton, Professor of Biology of the Christchurch University, New Zealand, on receiving two or three examples of this Crab writes as follows :—

"The male *Pinnotheres pisium* does not live in the bivalve, but wanders about; consequently he is rare, and only got by chance. I do not think the Crabs hurt the Mussels." I am, however, of opinion that occasionally the male Crab is found frequenting the bivalve, as among some 30 or 40 specimens obtained by me in the Derwent, three or four were most certainly males. Since receiving Professor Hutton's letter I find, on referring to Mr. Thos. Bell's able work, entitled "A History of the British Stalk-Eyed Crustacea," the following remarks respecting this particular Crab:—"The species of this genus are very remarkable from the peculiarity of their being indebted to animals of a very different class for protection, although not truly parasitic. They are found always to inhabit the shells of the Bivalve Mollusca, pincipally of the Genera Mytilus, Modiolus, and Pinna, and occasionally also of the Ostrea, Cardium, and other Genera. The males are always very much smaller than the females." Bell's remark as to the scarcity of males agrees with what came under my notice during the recent dredging trip. He further states:—"This species, *P. pisium*, is very commonly found in the common Mussel, *Mytilus Edulis*, on many parts of our coast, and especially in those which are found in rather deep water. On one occasion I dredged great numbers of these Mollusca on the coast of Dorset, and found by far the greater number of them with one or two of these little soft bodied Crabs within their shells; for the females are much more common than the males. The latter sex I have occasionally taken apart from the Mussel shells, the former never."

A large number of species of a delicate Echini were met with, *Echinocardium Australe*, Gray, described by Gray in 1851. This species is found to have a very wide range, having been obtained in the N.E. and North Coast of Australia, Japan, S.E. Coasts of New Guinea, East Indies, Cape of Good Hope, New Zealand, and New Caledonia. The first specimens obtained in Tasmania were collected by Mr. Ronald Gunn in 1850, and referred to by Gray in the "Annals and Magazines of Natural History," 2nd series, vol. vii., 1851. Two species of *Holothuroidea* were obtained, one species, *Cucumaria*, having five rows of ambulacral feet, the other species, probably a *Psolus*, having only three rows of tube feet on a kind of foot, like that of some Mollusca. I forwarded some specimens of Cucumaria and Psolus to Mr. Whitelegge, of the Sydney Museum, who is unable to identify them with any species found in the Australian seas, and is of opinion that they may be new species. Several interesting specimens of Hydroid Zoophytes were obtained, chiefly of the following species:—*Sertularella divaricata*, Busk; var. sub-dichotoma, Bale.

P. L. S., N.S.W., vol. iii. n.s., page 761. S. *microgonia*, Lendenfeld. Bale, P. L. S., N.S.W., vol. iii. pt. 2., s.s. p. 763, pl. xvi., fig. 8. *Halicornopsis avicularis*, Kirch. Bale, Cal. Hydroida, p. 185, pl. x., fig. 1-2. *Aglaophenia divaricata*, Busk. Bale, l. c. p. 162., pl. xv., fig. 7-8., pl. xvii., fig. 6-7. Several species of Polyzoa were brought up, the following species being determined:—*Catenicella Nastata,* Busk, McGillivray, McCoy's Prod. Nat. Hist. of Victoria, pl. 24, fig. 4. *Caberea Darwinii,* Busk, "Voyage of Challenger," vol. x., p. 29, pl. xxxii., fig. 6. *Amphiblestrum cervicorne,* Busk, McGill, McCoy's Prod. Nat. Hist. of Victoria, pl. 25. *Retepora carinata,* McGill, McCoy's Prod. Nat. Hist. Victoria, pl. 97, fig. 7. *R. avicularis,* McGill, l. c. pl. 95, figs. 7-11. *Cellepora rota,* McGill. Trans. Royal Society of Victoria, 1884. *C. albirostris,* Smitt, Busk, "Challenger's" Report, vol. x., p. 193, pl. 34, fig. 7, pl. 35, fig. 3. *Amathia tortuosa,* Tenison-Woods. Trans. Royal Society of Victoria, 1880. *Pustulopora Australis,* Busk, Brit. Mus. Cat. Polyzoa, pt. 111.

Several specimens of an alcyonarian coral were also obtained. *Acanthoisis flabellum,* Wright and Studer, "Challenger's" Report, vol. xxxi. p. 45, pl. xii. fig. 1. Sponges some five or six species were obtained. Examples I intend to have forwarded to Mr. A. Dendy, Demonstrator in Biology, of the University, Melbourne, for identification, who is at present paying considerable attention to the Spongidæ of Australia. Several specimens of Foraminifera were obtained. Mr. Durrand has kindly mounted an excellent slide for the Society, containing several genera.

From the large number of interesting specimens obtained during our recent dredging trip, and considering the very primitive and unsuitable dredge we had to use, I am convinced that a most interesting and valuable collection of marine fauna may be obtained in the Derwent, and have decided that during the summer months I intend to carry out a similar system of dredging to that I was engaged in for the Sydney Museum on the Queensland Coast and Port Jackson during the years 1879, 1881-82.

DISCUSSION.

In reply to His Excellency, Mr. MORTON described the localities where the dredging operations were carried on, and said that the biggest haul of scallops was found round the powder hulks near Government House. One gentleman from England described them as equal to the European quality.

Mr. CURZON ALLPORT said he would expect to find the largest bed of oysters near the entrance to the D'Entrecasteaux Channel. He knew oysters had been taken from there, and believed that many of the oysters found at Brown's River had come from that locality. Touching the scallops, they were at one time very numerous and were brought to market in considerable quantities. He now looked upon them as coming back again of late years like the oysters and mussels. Recently some good specimens had been obtained off Long Point, Sandy Bay.

Mr. MORTON said that since the dredging operations three oysters had been brought in from New Town.

Mr. CURZON ALLPORT said he had seen casual ones this side of Kangaroo Point.

NOTES OF SOME GEOLOGICAL OBSERVATIONS ON THE WEST COAST.

By A. Montgomery, M.A.

During a short visit to the mines of the West Coast in March of this year, I was able to make a few cursory observations of some geological features of the ground travelled over; and a few notes and remarks on these I have the honour to lay before you to-night. Travelling, as I was, rapidly, and for the set purpose of visiting the mines in the shortest possible time, I could not delay long enough to study the numerous interesting questions that presented themselves, and in this paper you will find that I rather state problems than contribute much towards their solution. By calling attention to points requiring elucidation, I hope that the numerous visitors to these till lately almost unknown districts who may have a taste for geological observation, may be induced to notice and record any facts that they may come upon that will throw light upon them. All facts thus noted and made known are stones cut ready for the hand of the builder, who will in time rear them into a noble temple of knowledge. In a newly-opened country we must first collect facts, however disconnected they may be; generalisations from them and complete knowledge will follow in due course. If these jottings, then, serve as foundations for more elaborate work, they will serve their end to the utmost of my hope.

On this occasion my route lay from Strahan to Mount Lyell, thence to the Howard Plains and back to Strahan, then on to Trial Harbour, Mount Zeehan, and Mount Dundas, then overland by Corinna and the Heazlewood silver field to Waratah. It was only such features as were apparent on the roadside that I could see at all. The keys to numerous questions to which I could give no answer may have been lying close at hand, but I could not delay to search for them.

The most interesting subject for geological research on the West Coast appears to me to be the relation to one another and to the sedimentary formations of the numerous igneous rocks, and the influence exerted by these upon the mineral contents of the mining districts. These igneous rocks comprise granite, greenstone, serpentinous greenstone, basalt, and a doubtful rock which may be diorite. Granite forms the mass of Mount Heemskirk and the Meredith Range, and is also encountered on the Magnet Range, near Mount Bischoff. As quartz porphyry and eurite it comes in at Mount Bischoff itself. This porphyry is clearly intrusive through the slates there, as fragments of slate and sandstone are frequently seen embedded in it, and the workings of the Mount Bischoff mine also show it ramifying through the slate. One of the problems to be solved is the relation of this porphyry to the main granitic mountain masses; is it contemporaneous with their upheaval or intruded long subsequent to their formation?

The greenstones and serpentinous rocks are of much interest, more particularly as the serpentine at the Heazlewood is itself the matrix in which metallic lodes are found. There is probably more than a mere coincidence in the fact that serpentinous rocks are found in the vicinity of our three silver-lead fields, Mount Zeehan, Mount Dundas, and the Heazlewood. The intrusions of greenstone are met with in several somewhat widely-separated localities. On the road from Strahan to Mount Lyell, from the Queen River Hotel to about a mile past Lynchford, there is a large greenstone mass, which also is crossed by the prospectors' track from Lynchford to the Howard Plains nearly to the Queen River. As far as I could tell (without analysis and microscopical examination, this rock is exactly the same as the greenstones which are so extensively developed in the central and eastern portions of the colony. I did not notice in it the change to serpentine that is shown by some of the other greenstones I have to speak of. Presumably, it has been intruded through the Silurian sandstones surrounding it, but its effect upon these as to local metamorphism, contortion, fracture, and mineral contents, has yet to be learned. It would be instructive to know if the veins and lodes of quartz traversing the Silurian strata are in any way affected by it, or show any evidence of having been caused by it.

Round Trial Harbour for about half-a-mile to the north and east there are steep hills of serpentinous greenstone, which decomposes to a dark red-brown barren soil, containing much magnetic and titaniferous iron ore. It is probably part of the same set of intrusive basic rocks as the serpentinous greenstone found nearer Mount Zeehan, extending for about 3½ miles from above the Agnew Huts nearly to the Comstock mine. At the western side this rock has not been greatly altered, and is much like our common greenstones, but towards the east it gets more and more changed to serpentine. The razor-back ridge on Handley's section at Mount Dundas is somewhat similar serpentine, only finer for ornamental purposes, and contains asbestos and titanic iron ore. Serpentine is also found all along the boundary line of sections

$\frac{2303}{87}$ and $\frac{1851}{87}$, apparently forming the back of the hill into the face of which the Mount Dundas Company's tunnel is being driven. Though the serpentine rocks at the Heazlewood are considerably distant from the above, their similarity in lithological character would lead one to suppose that they also are related to the same series. They first appear on the road from Corinna to Waratah, at about thirty chains past the 21 mile post, at what are called the Eighteen-mile Huts. From there they extend on to past the Heazlewood and Heazlewood Extended mines. On the track from the Heazlewood to the Specimen Reef mine the serpentine extends to about half-a-mile from the crossing of the Savage River. The stone varies very much in appearance, from a greenstone to almost pure serpentine. Parts of it contain much schiller-spar, and closely resemble gabbro. The appearance of all these serpentinous greenstones is consistent with the theory that the rock is a dolerite or gabbro, with its constituents metamorphosed by schillerisation, or internal chemical change, and by weathering, or external atmospheric influences. The more or less complete alteration into serpentine is probably due to the unequal distribution of olivine in the original rock. The change of olivine into serpentine would also account for the formation of the magnetic and titanic iron ore so common in portions of the rock. An interesting deduction from the appearance of these greenstones is that they were once very deeply buried, schillerisation being believed to take place only at great depths. It is possible, then, that these are the roots of one time mighty volcanic masses, possibly covering the western side of the island with their lavas. The microscopic study of these rocks promises a most fascinating field for the petrologist. Should there prove to be grounds for the idea I have advanced, that the volcanic rocks were once much more widely spread than now, the mineral nature of the country would be to some extent explained, the conditions being then such as may be presumed on many grounds to have been favourable for the formation and filling of mineral veins. Every fact that can be adduced to illustrate the history and relations of these intrusive masses will be of service to the cause of geological science in many ways. It has occurred to me that these old matamorphosed igneous masses may possibly represent the lower members of the great greenstone flows that have covered so much of the colony.

Throughout the mineral fields of Mount Zeehan, Mount Dundas, and the Heazlewood, there is another set of igneous rocks that appear to be of quite different character from the greenstones. They seem to be closely connected with the mineral veins, and when more is known about them, I am inclined to believe that the connection will be found to be even closer than it at present appears. They are so much decomposed wherever I have met with them that it is quite impossible to name the rock with any accuracy. As far as can be judged from the decomposition products, it must have been chiefly composed of felspar and hornblende without free quartz, and is likely therefore to be a diorite or hornblende andesite. Till further research reveals its true nature we may without much inaccuracy speak of it as a dioritic rock. I noticed it more especially at the Mount Zeehan and Whyte River Silver-fields, but at Mount Dundas there are also rocks of this series. At Mount Zeehan it is found plentifully on the main road between the Comstock and Silver Queen holdings, some of the belts being close on a quarter of a mile in width. It is notable that the slates in this vicinity are much contorted and broken by small faults, as may be seen in the roadside cuttings. The dioritic rock is most easily distinguished by its coarse granular appearance on the fresh fracture, and by its clayey nature, being almost free from grit. On the surface it forms a stiff yellowish brown clay, quite unlike the dark red-brown clay resulting from the weathering of the serpentines. In the Argent, Balstrup's, Silver Spray, and Western mines it is cut through by tunnels, also in Evans's section $\frac{1110}{87}$, and a dyke of it was noticed in section $\frac{1470}{87}$ of the Tasmanian Silver Mining Company. In Balstrup's and the Western mines it clearly occurs as dykes penetrating the Silurian country slates and sandstones. In the Argent tunnel no lodes were met with in it, but some veins of pyrites and loosely coherent quartz crystals were passed through. The inner end of the adit is in clay slate, the outer half being in the volcanic rock. This has here much the appearance of a tufa, and may prove not to be a weathered dyke penetrating the slates, but a tufaceous bed resting upon them. In the lower tunnel of the Silver Spray company the igneous rock is clearly of a fragmentary character, containing numerous angular fragments of clay slate imbedded in the clayey matrix of weathered volcanic rock. Here we probably have a remnant of a tufa bed, most likely one of many that were formerly widely spread over the district. Some quartz veins were found in this tufaceous rock, and on the surface there is a large mass of gossan, supposed to have been the cap of a lode, until the tunnel was driven underneath it and far past the line of it on the surface without success. Quartz veins and a lode of quartz of considerable size are also found traversing the dioritic dyke in Balstrup's section, and in the similar dyke near the Whyte River on which Godkin's, Smith and Bell's, and the Whyte River company's claims are situated, quartz veins have again been found. The outcrops of both these dykes, too, are marked by large masses of gossan. It appears to me that the weathering of the dioritic rock is of itself quite capable of producing deposits of iron ore on the surface, without there being any lodes required to account for their formation. The ferruginous waters resulting from the solution by carbonic acid of the iron of the rock on coming to the surface are sure to deposit their iron as hydrated oxide. A gossan formed in this way would be rather a bog iron ore than a true lode gossan; and many of the so-called gossan outcrops on these silver-fields appear to me rather to be beds of surface bog iron ore than true gossans. The highly ferriferous serpentine rock has yielded much surface bog iron ore in the same way, as may be seen on the road from Trial Harbour to Mount Zeehan, almost immediately after coming upon the serpentine. Too much importance should therefore not be attached to gossan outcrops as indications of mineral lodes. In this connection, too, I may point out that it frequently happens that quite a small lode has a large "iron hat" owing to the ferruginous waters issuing from it spreading over the surface of the ground. A big "gossan blow" need not cover an equally big lode by any means. In making these remarks I am not forgetting that in Smith and Bell's section the gossan is in at least one place clearly derived from the oxidation of a lode containing much carbonate of iron.

At Mount Dundas I did not notice any dioritic dykes, but in the southern of Webster and Bennett's sections I found a volcanic breccia of fragments of felspathic rock, similar to the diorite. In all probability the igneous rocks will prove to be common at Mount Dundas as well as at Mount Zeehan. Their intrusion may have been the cause of the fractures in which the lodes formed, and the solfataric action accompanying volcanic activity may have had much to do with the filling of the fissures with their mineral contents.

Between the Whyte River and the Magnet Range there is a large quantity of a rather fine-grained greenstone, which does not closely resemble the serpentinous greenstone on the west side of the Heazlewood field. In the cuttings for the road on the long grade down from the top of the Magnet Range, this rock is seen penetrating the slates and altering them to hard brown porcelain-jaspers. I am not at all clear as to whether this is not yet another separate igneous intrusion. Analysis and microscopic comparison with the other greenstones are required to solve this problem, together with field observations to the northward of the Whyte River silver-field, where the Magnet Range greenstone seems likely to join with the serpentine rocks.

The basalt dykes and flows met with on the West Coast all probably belong to the series of tertiary basalts found abundantly along the North and North-West Coasts. About 10 miles and 8 miles south of Corinna I noticed two dykes or streams of basalt crossing the road, the first about a quarter of a mile wide, the second about half that width. It occurs again at 21 miles from Corinna on the road to the Heazlewood, and on the track to the Specimen Reef at about one and a half and quarter miles from Hall's Creek. Round Waratah it is rather extensively developed. Looking southward from the top of Mount Bischoff it appears likely that the plateau, out of which Mount Pearse stands up like an island from the sea, is all basalt. If this is the case there is a very interesting geological problem here, to determine as far as possible the configuration of the country previous to the lava flow. This may have important economical results in leading to the discovery of buried tin-bearing leads heading from Mount Bischoff. Ever since the discovery of this wonderful ore deposit, the small quantity of alluvial tin ore found in the creeks running from it has been a subject of surprise to observers, and the existence of leads buried under the basalt has frequently been conjectured. The interesting leaf beds underlying the basalts at Waratah have more than once been brought under the notice of this Society. As usual, the basaltic soil appears to be very fertile, and in the event of a large population becoming established on the West Coast, these strips of good land will doubtless be very valuable for farming purposes.

The questions connected with the igneous rocks are by no means the only interesting geological problems that present themselves. Others there are in profusion, apparent even to the cursory glance of the passing traveller. I may mention some of these, not to throw any light upon them, but merely to direct attention to them. The Tertiary leaf beds fringing Macquarie Harbour have been scarcely at all studied as yet, though Dr. Milligan and Mr. R. M. Johnston have made a valuable beginning and given us a glimpse of the riches there awaiting both botanist and geologist. The sand dunes through which the railway passes between Strahan and the Henty River also deserve some attention. They extend inland from the beach for a very considerable distance, and are now covered with a dense growth of ti-tree scrub. Are they overlying the leaf beds, or do they lie against the face of an escarpment of these such as we see at Strahan? The latter seems to me at present the more likely. But apart from their geological age these dunes suggest some interesting questions: How have they been formed? Have they been caused by the sand being blown inland from the beach, as we know sand dunes frequently are formed, encroaching on low-lying coast lands and gradually covering them, or has their growth been quite in the opposite direction by the sand accumulating on the beach gradually extending further and further seaward, and so reclaiming a strip of shore? If, as seems likely, Macquarie Harbour once had a wide mouth instead of a narrow one, and the sand driven southward by the north-westerly winds has gradually formed a sandspit from Strahan to the Heads, it seems likely that the dunes represent successive lines of sandhills formed above high water mark, and that the land has been reclaimed by the constant deposit of sand brought in to the shore by the action of the winds and waves. The reclamation would be similar to that which often takes place in the angle where a breakwater meets the shore line on the side exposed to the prevailing winds and currents. In this case Cape Sorell and the strong current from the Harbour would be the obstacles preventing the further southward travel of the sand, and causing it to accumulate on the beach to the northward. If this suggestion is correct, the depth of the deposit of sand is probably considerable, much more so than if the dunes were formed by the action of wind alone. Perhaps some of the railway cuttings may throw some light on the question. It is interesting from an engineering as well as from a geological point of view, and has a certain bearing upon the proposed harbour works at Macquarie Heads. From its geological aspect, a section through such a sand deposit as I have indicated would exhibit an instructive succession and overlap of horizontally bedded sands, false bedded sands, and blown sands.

The gravel deposits in the neighbourhood of the Pieman River and along the road from Corinna to Long Plains deserve some attention. They cover a large extent of country, and are found at very various levels, and they appear to have been laid down when the river systems were not altogether as they now are. As gold has been found almost universally in these gravels, though in small quantity, they may become of economical importance, and leads may be found in them. Their distribution and formation are therefore worthy of study.

An alluvial deposit at the Linda River, in the neighbourhood of Mount Lyell, where sluicing operations for gold are being carried on, also came under my notice. The streams that piled up the auriferous gravels were probably much larger than those now existing. Under the gravel there is a peaty bottom, containing very numerous fragments of wood, apparently of one of the pine family. Below this bottom another layer of gravel has been found in places. Search would probably reveal leaf beds, from which valuable information might be obtained. The alluvial flat through which the Linda Company's tail-race runs, may very probably have been at first a small lake, then gradually filled up to a marsh, and finally covered over with a layer of gravel. If so, what force scooped out the Lake basin? Was it a glacier, or has a landslip blocked the exit from a valley, and so formed a lake?

There are any number of other points on which information would be useful, sometimes purely in the cause of science, but oftener, perhaps, on account of their bearing on the mining industry; but in rapidly traversing the district as I did, it was of course impossible that I could take any note of nine-tenths of them. For example, I had no time to look for fossils, though some of the localities passed through are evidently rich in them, and if one had the opportunity of examining them, doubtless many discoveries would result. A cutting in the main road close to the Government township of Mount Zeehan is especially rich, and will doubtless be much visited by collectors on account of its easy accessibility. The sandstones between the Heazlewood and Whyte Rivers are also fossiliferous.

In conclusion, I have to say that these notes are given for what they may be worth as to the facts related in them, for I confess I attach no importance to any theories I have indulged in, and am quite prepared to find that further exploration will disprove them, or cause them to be altered beyond recognition. If I have succeeded in drawing your attention to the extent and variety of the geological harvest that stands waiting to be gathered, I shall have done all that I can hope for at present.

At some future time, after the more elaborate examination of these districts, which, as time goes on, I hope to have opportunities of making, I trust that I may have the honour of bringing under your notice solutions of some of the problems that to-night I have only been able to mention as existing.

OBSERVATIONS ON THE INFLUENCE OF STRIKES UPON REAL WAGES.

By R. M. Johnston, F.L.S.

At the present moment in Europe, America, and Australasia, many industries are paralysed and the well-being or comfort of thousands of families are more or less sacrificed by organised or enforced idleness involving a considerable diminution in the creation of commodities or real wealth. These Strikes, as they are termed, are entered upon by thousands of honest, hardworking, peace-loving men. In loyalty to their order and to their recognised leaders, they display many characteristics which cannot but excite some degree of wonder and admiration; for this voluntary suspension of the means of livelihood to them not only involves unflinching self-denial of ordinary comforts, but also the facing of a terrible risk that in the dark, prolonged struggle, the lives of those that make life dear to them may be crushed and overwhelmed by want and misery.

Facing such risks, it is only natural that the ordinarily peaceable man should become restless and excited, nay, violent, when the campaign of self-sacrifice and loyalty to their fellows seems about to be jeopardised by the opposing action of those who seem to them to be lawless renegades of their order.

Those of the community whose interests are in conflict or are not supposed to be immediately affected by a combined strike—whether for shorter hours, resistance to the lowering of the rate of wages, or the raising of wages—may be surprised and may condemn "unionists" on Strike for violently opposing the filling up of their places by so-called outsiders, freemen, non-unionists or blacklegs, but a little consideration from the standpoint of "Put yourself in his place" will reveal much that tends to palliate their modes of action or behaviour, if it does not exonerate or justify them. Be it remembered that their hope of success entirely depends upon their loyalty to each other under the most severe strain to human beings, viz., privation and misery; that their battle squares, if broken entails defeat; that the breaking away of any of their number or the intrusion of opposing outsiders destroys all their hopes, make their prolonged sacrifice of no avail, and leaves them in a much worse position than at first.

On the other hand (making allowance for mistakes in judgment), there is much that is admirable in the sympathetic, sacrificing support of brother workmen in other trades or divisions of labour, who, although not themselves immediately concerned, yet voluntarily resolve to help by docking 1s. per week from their own small earnings, nay, often sacrifice for a time their earnings altogether where it is thought that a Strike in their own branch would serve more speedily to bring their brother-workers' campaign to a successful conclusion.

In the present day—with its hard and fast divisions of labour, its fluctuations of demand and supply, its hordes of unemployed, and its crushing competitive rings and interests —the intelligent wage-earner perceives plainly enough that as a unit he is perfectly helpless, and that he can only succeed in bearing up against opposing organised interests by a similarly organised action.

No one who has closely followed the struggles of workmen during the last thirty years can fail to perceive that upon this organisation (solidarity) rests the whole strength of their position in the industrial scheme, and that anything which tends to weaken or demoralise their centres of organisation, meets with their most strenuous resistance; for it is manifest to them that the breaking or weakening of the heart or centre of their organisation detaches them again to helpless units who are unable to enforce any claim whatever.

It will be conceded, therefore, when it is proposed to ask the question, *Can Strikes raise Real Wages of Wage-earners all round?* that the writer is one who regards combination or co-operation amongst wage-earners as of paramount necessity to them, and that when all better modes of appeal for reasonable concessions are unavailing, the last and terrible resort "to Strike" may in certain cases not only be justifiable but imperative.

STRIKES CAN ONLY SUCCEED IN RAISING *Real Wages* WHEN IT IS PARTIAL OR CONFINED TO INDUSTRIES THAT COMPRISE A SMALL PROPORTION OF THE COMMUNITY.

While much has been granted in favour of organisation, and the right to resort to Strikes under certain circumstances, it cannot be concealed that many expect by organised Strikes to effect what is plainly an utter impossibility, even if employers gave way at every point.

A Strike may be the means of successfully raising the status of some branches of labour that are comparatively underpaid or over-worked; it may raise the *real wages* of a particular country or locality which formerly laboured under the average remuneration of other countries; it may temporarily be the means of forcing the capitalist or employer to give a fairer or larger share of the profits of capital and labour—*i.e.*, machinery plant, skill, and labour—but from the very nature of the common source of all profit and wages [viz.—the *current products* created by the combined services of capital (instruments) and labour], Strikes cannot raise the *real wages* of *all* wage-earners.

In other words, it is possible to regulate and alter the distribution of the aggregate wealth of consumable necessaries of life, but so long as this aggregate wealth fails to be increased per capita per year, Strikes cannot increase the *real wages* or the purchasing power of a day's labour of *all* wage-earners. In a word they cannot divide more than what has actually been created or produced, although the *nominal rates of wages* and *nominal prices of commodities* may both be raised to any extent without real benefit to anyone.

To secure a general nominal rise of wages in *all* branches of labour would further have the immediate effect of lowering once more the *real wages* of those who already had effected for themselves an advantage by successful combination or Strikes. This may seem hard to believe by many who have not taken the trouble to discern the fundamental distinction which exists between *real wages*—which alone can improve the workman's condition—and *nominal wages*, which, if raised ever so high, in all branches of labour, leaves the workman just in the same condition as at the beginning.

But, directing the attention to the fact that there is an important distinction, it may prepare the more thoughtful to contemplate that there is something underlying these terms which they would do well to understand, for it cannot be too often asserted that Strikes might possibly raise the *nominal wages* of workers all round a hundred-fold, and yet result in the positive lowering of the *real wages* of all workmen who, by means of organisation, hitherto have succeeded in bettering their condition as compared with their less perfectly organised fellow-wage-earners. It is the failure to recognise the essential difference between *real* and *nominal wages* that renders futile the many schemes of sentimentalists, which have for their object the laudable design to improve the condition of the people.

Real and Nominal Wages.

No one has more clearly defined the nature of *real* and *nominal wages* than Mr. George Gunton, in his admirable work "Wealth and Progress." He states (p. 74): "By *real wages* is meant the actual amount of wealth (social well-being) obtainable by a day's labour. By *nominal wages* is meant the amount of *money* obtainable by a day's labour." In other words *real wages* means the actual purchasing power of a day's labour, while *nominal wages* may or may not always afford a correct index of the comparative purchasing powers of a day's labour. For example, in England the minimum supply of the necessaries of life for a workman and his family for one day may be secured by a nominal expenditure of 4s. in money. If his nominal or money wages for a day of nine hours be 5s. then the purchasing power of his real wages for one day's labour is equivalent to the command over 1 1-5th days of the necessaries of life. If the same necessaries exactly in America cost a nominal or money value of 6s., it follows that a nominal or money wage of 7s. 2·4d. for a nine hours day in America would only have the same purchasing or real wages value as the nominal or money wage of 5s. per day in England.

Now, as it can be shown that the nominal cost of a day's labour mainly determines the ultimate nominal cost of the commodity, product, or service related to that effort, it follows that if *nominal wages* all round were arbitrarily raised 20 per cent. without actually increasing products, it would inevitably result in raising the *nominal* prices of commodities or necessaries all round to the same extent, and thus leave the purchasing power or *real wages* of the labourer in the same position as at first.

It has been purposely assumed that this effect would only be brought about where the arbitrary increase to *nominal wages* was equally spread over all classes of wage-earners; for it is not denied that an arbitrary increase to *nominal wages* if restricted to a few industries might increase both the *nominal* and real wages of these trades; but in all such cases it would be obtained by a proportionate *decrease* of the purchasing power or *real wages* of every other class in the community who were obliged to purchase the products so enhanced in price of the various industries who succeeded in having the *nominal* wages so raised. It is the consumers of products or services who would ultimately lose by the advantage gained by the industries whose wages were nominally raised, and not the capitalists and employers who directly were obliged to advance the *nominal wages*.

It is only under such restricted circumstances where Strikes could really benefit any industry by raising *real wages*. They would of necessity fail to raise *real wages* if the *nominal wages* of every class were raised by the same percentage of increase as has already been explained. Unfortunately the workers in many industries whose labour is worst paid (*e.g.*, seamstresses and agricultural labourers) lack organisation, and thus fail to improve their position among other labourers, although the nominal cost of the necessary satisfactions of life is the same to them as to the better paid wage-earners. But here again it must be borne in mind that any increase in *real wages* gained by them by the nominal raising of wages could only be secured where the *nominal* increase to wages is restricted to a few industries. This is made all the more apparent when we try to estimate (however roughly) the composition, numbers, and nominal earnings of the various classes of any Society.

It is impossible with our present knowledge to gauge all such conditions accurately, but if, for example, we divided all Breadwinners—Rich and Poor—into, say, five distinct groups, thus—

		ASSUMED PROPORTION.		
1. Upper Class Rich, say	...	1	per cent. of	Breadwinners.
2. Middle Class „	...	5	„	„
3. Higher Industrial ... and Artisan „	...	15	„	„
4. Middle Industrial „	...	20	„	„
5. Lower Industrial „	...	59	„	„
		100		

If, further, the total satisfactions secured per day amounted to £33 6s. per 100 Breadwinners, and were divided as follows:—viz.: for the 1st, 40s.; 2nd, 20s.; 3rd, 10s.; 4th, 7s.; 5th, 4s., we may ask—What, then, would be the effect upon all if the satisfactions were equally distributed according to the day's labour, disregarding the nature, quality, or quantity of the work or service performed by the various classes? Some indication of the effect that would be produced is shadowed forth in the following table:—

	Percentage proportion.		SATISFACTIONS PER DAY		Total Satisfactions if equally distributed.	Increase or decrease per cent.
			Assumed existing proportion.	Total. s.	s.	
1. Upper Class Rich	1	@	40s.	40	6·66	— 83·3
2. Middle Class	5	@	20s.	100	33·30	— 66·7
3. Higher Industrial & Artizan	15	@	10s.	150	99·90	— 33·3
4. Middle Industrial	20	@	7s.	140	133·20	— 4·8
5. Lower Industrial	59	@	4s.	236	392·94	+ 66·5
TOTAL OR MEAN ...	100		6·66s.	666	666	——

From the preceding table it would appear that if all classes shared equally in the satisfactions assumed to be created by the aggregate labour of men, only the lowest would receive a positive increase, while the four higher would lose a considerable per centage, amounting to a decrease from $4{\cdot}^{8}$ per cent. in the Middle Industrial to $83{\cdot}^{3}$ per cent. in the Upper Class Rich share. Even the Higher Industrial and Artizan Class, who often dream that a redistribution of wealth would be to them of untold advantage, would, as shown, probably lose $33{\cdot}^{3}$ percentage of their present allotted share of created satisfactions if the world's created wealth were equally distributed among all men.

This equality of distribution is the dream of many

NOTE. — Indicates Decrease. + Increase.

Socialists, whose present share of the satisfactions of life would certainly have to be lowered, not raised, if their visionary schemes could be carried into effect.

In conclusion it seems only too true, as asserted by Mr. Gunton, "That nothing can improve the social condition of the masses, whether it raises nominal wages or not, which does not increase the general rate of *real wages*, the degree of which may be universally taken as the accurate measure of social progress;" and, "there are no economic means by which the material condition of the masses can be permanently improved which do not tend to increase the aggregate production of wealth per capita." Invention, increasing command over the forces of nature, thrift, and industry can alone accomplish this. Schemes of Distribution and Strikes for higher nominal wages must end in failure and disappointment, so far as the great masses of men are concerned.

It would be well for capitalist and wage-earner, employer and employed—whose interests as producers and *consumers* are almost identical—that when matters requiring adjustment are proposed, there should be greater facilities afforded in the Councils of both interests for securing a friendly settlement. So long as high-handed action on either part bars the way to the friendly conference of *acknowledged representatives* (except after the bitterness and friction of an industrial war), so long will the unsatisfied claims, the suspicions and misunderstandings of both parties, result in injury to both; and to the absence of these facilities, mainly, may be attributed the most disastrous of all such evils, viz. Strikes.

CAN STRIKES REALLY IMPROVE THE CONDITION OF THE MASSES?

By A. J. Ogilvy.

The question—the very serious and practical question raised in Mr. Johnston's late interesting paper is this—Can the toiling masses really improve their condition by these incessant and unhappy Strikes, or are they only beating their hands against the iron bars of inexorable Economic Law?

That, at any rate, whether it exactly represents what Mr. Johnston meant or not, is the great question of the day; and it seems a very plain question. Yet, plain as it seems, one or two other questions appear to have got rather mixed up with it which are no part of it all. For instance, the question is not whether if all nominal *incomes* were raised real incomes would be raised too, and that if everybody had twice as many shillings, other things being unaltered, everybody would be twice as well off.

The most ignorant striker does not imagine this for a moment. He understands perfectly well that the increased pay that he expects to get must come out of somebody else's pocket. Neither is the question whether "men can divide amongst themselves more than is created or produced." Of course not. We might as well be asked to debate whether 2 and 2 could make 5. That is not the great Strike question.

Briefly summarised, the proposition placed before us in Mr. Johnston's paper is that strikes, if carried out on any extended scale, must fail, because a mere increase of nominal wages, unaccompanied by any increase in production, cannot really improve the condition of the masses. The aim of this paper is to show that it can. The proposition indeed ought to be reversed and stand thus:—No increase of production can improve the condition of the masses unless accompanied by an increase of nominal wages. The nominal wages are the main thing, because it is not an increase of production, but an alteration of distribution that is aimed at.

What we are concerned with is an increase of *wages*, that is, of the income of the *masses:* of the lower 10 millions whose toil is the active factor that produces all wealth, not of the upper 10 thousand who in some mysterious way manage to get rich upon that toil.

Society, in the view of the masses, may be roughly divided into 3 classes:

(a.) Those who derive income absolutely without any effort of their own, and consequently from the efforts of other people. Of these are receivers of ground rent, holders of state bonds, money lenders, shareholders in companies, and so on.

(b.) Those who do contribute some effort, but effort absurdly disproportionate to the income they receive. For example, the manufacturer who makes some thousands a year by only some 4 or 5 hours attention to business a day, while his factory hands only get £1 a week or so for some ten hours work a day.

(c.) Lastly come the toiling masses who bear practically the whole burden and heat of production, and yet gain but a mere subsistence. This last class thinks that the two first classes get much more than their fair share, and it strikes in order to make them disgorge. A strike, then, is a movement of the underpaid against the overpaid.

Whether the two first classes do really get more than their due is a matter that we have nothing to do with at present. We are not concerned with the ethics of the question. All we have to enquire is, not whether strikes *ought* to succeed, but whether they *can*.

In the primary industries, that is in those which are concerned in extracting or producing the raw materials of wealth from the land (as in agriculture and mining), where certain lands only are suitable for the purpose (as for instance fertile lands for agriculture, and mineral lands for mining), and the intending users are much more numerous than the owners, there is keen competition for possession of such lands, and the competitors run each other up in rent. In all such industries every increase of wages will come out of the rent. For rent (or, at any rate, that portion of it which we are now concerned with) is simply the surplus which remains after paying working expenses and tenants' "ordinary profit;" and every rise in the expenses or fall in the profits will reduce the rent proportionately. Take agriculture. In every lease the rate of wages and the price of produce is tacitly accepted on both sides as the basis of the whole calculation; and both landlord and tenant understood quite clearly that if wages rise or prices fall, not as a mere fluctuation, but with every appearance of "settled weather," the rent will have to be re-adjusted at the first opportunity. But royalties on minerals are but rent under another name, and are determined by exactly the same calculations. Think what a vast area of industry, and how great a body of workers are represented in this category! It includes the raising of every description of crop, and all grazing, dairying, and many other products; also all coal, iron and metal of all sorts, building stone, slate, lime, china, and brick clay, and minerals too numerous to mention, in all which every increase in the cost of the working will come out of the rent. It covers also not only all those who are actually on the land, but all who are directly or indirectly engaged in providing the appliances or placing the product in the market. A strike of the seamen who carry the coal, or of the artificers who make the mining appliances, will fall on the landlord as surely as will a strike of the actual miners, and for the same reason, viz.: that it increases the cost of placing coal in the market, and so leaves a less surplus available for rent. In every department of industry, then, which is concerned in supplying the raw material of wealth from the land, every enforced rise of wages will be clear gain to the labourer, because the loss will fall upon the landlord, *and stay there.*

But in the secondary industries; in those industries which are concerned, not in extracting the raw materials of wealth from the land, but in working up and distributing those materials (as in manufactures and commerce), in which the land is not an active factor, so to speak, in the work, but is required only as a site, one site doing (within certain limits) as well as another, where consequently trade competition is not for possession of the land but for custom, and the competitors run each other down in price instead of running each other up in rent. In all these industries increased wages will signify increased price of goods.

But these goods again are of two kinds, those which the masses consume, and those which they do not. On those which they do not consume no increase of price will affect them.

Few people realise how vast a proportion of the industry of a rich country like England is concerned in providing luxuries and enjoyments for the rich. Taking goods only, and putting mere services aside, one has only to walk down the street glancing in at the goods displayed in the shop-windows to see that the greater part consists of goods quite out of reach of the masses, and in which consequently no increase of price will concern them. The butchers and bakers, the grocers and the clothiers, are the chief shops which the masses deal with, and even in these, in the two latter at any rate, the greater quantity, whether measured in variety or in value, consists of articles of luxury available only to the well-to-do; while in many shops the display exhibited contains hardly a single article within reach of the poor.

In all those commodities, then, which the underpaid do not consume, the loss due to increased wages will fall upon the overpaid, *and stay there,* again leaving the whole net gain to the labourer.

Lastly we come to those goods which the masses do consume, and which will rise in price. Here the strikers will suffer a loss, but the loss will not equal the gain even on these goods. In the case of primary products, such as food, the greater part of the loss due to increased wages will, as we have seen, be deducted from the rent instead of added to the price.

In the case of secondary products, manufactured goods, as say for example *boots*, the cost will be added to the boots; but it will not be all piled upon the labourer's boots, the boots of the overpaid will bear their share. If in consequence of a bootmakers' strike an increase of *£1,000* in wages had to be paid for a given turn out of boots, then *£1,000* would have to be added to and distributed amongst that turn out of boots; the overpaid would have to bear all the added cost that accrued to their boots, leaving the underpaid to bear that part only which accrued on *their* boots; and the share that the overpaid will have to bear on their boots is not to be measured merely by their numbers, for the boots used by a rich man are generally much dearer, representing a good deal more labour than the boots used by a poor man.

To sum up so far, let us express the argument in figures; not pretending for a moment that the figures are even approximately correct, but simply to illustrate our meaning.

Suppose then that in consequence of a series of concerted strikes among the whole class of labourers wages generally were increased by £30,000 a month, we might say that—

10,000 would be taken off rent instead of added to price.

10,000 more would be added to price, but to price only of goods which the strikers did not consume.

And of the remaining *10,000*, ⅕ (or *200*) would be paid by the richer classes who consumed their share of such goods, leaving only *8,000* to be borne by the strikers on *their* share.

The profit and loss account to the strikers would then stand thus—

Taken out of rent and added to wages	10,000
Levied on rich purchasers of luxuries and added to wages	10,000
Levied on necessaries and small comforts and added to wages	10,000
Total	30,000
Deduct increased price on strikers own purchases	8,000
Net gain to the strikers	22,000

It is said, however, that if the upper classes lose so much there must be so much the less employment for labour, and so the loss will come round to the labourer after all.

There will be no less employment.

For why will the upper classes have got so much less? Simply because the lower class has got so much more. It is not a loss but a mere transference of employing power. What the masses want more money for is to spend it, and they can only spend it in purchasing goods and hiring services just as the upper class did. They will in short, to the extent of the transference, be employed by each other instead of by their old employers.

My time being limited, I have been obliged to state my case in broad outline, without going into details and qualifications, but there are one or two such qualifications, real or apparent, that we may have time to glance at.

1. There is of course a limit to the rise of wages. The labourer cannot earn more than his labour produces. But this limit is a long way off; what the labourer actually gets is a very small portion of what his labour really produces; and the question before us is not whether there is such a limit, or how far off it is, but whether strikes, as strikes, can under present circumstances really improve the labourer's condition or not.
2. It will be said that the fall of rent which we have predicted will throw some lands out of use, and so actually diminish the total production of wealth. That is to say, that land that now yields current wages to labourers, and profit to employers, but only a small surplus for rent, will then yield no rent at all; in which case the landlord will withdraw such land from use and devote it to his own amusement, say for sport.

Well, that opens up a question about which you will hear more before long, viz.: the question whether a man who claims to be sovereign lord and master of a certain portion of the earth's surface shall be allowed deliberately to prohibit all productive industry on that area, to forbid willing labourers from working, and enterprising capitalists from investing merely because such enterprise will not yield blackmail to him, as well as profit and wages to the workers.

But passing that by, I would point out:

1. That a more equitable distribution of the produce of labour is a boon so great in itself as to be well worth some cost, and that we need not be dissatisfied because less luxuries are produced for the few very rich, if more comforts are provided for the many poor; not even though the loss in value on the luxuries exceeds the gain in value on the comforts.
2. That it is only the very worst lands that will be withdrawn, and the loss through the withdrawal of these worst lands will be more than compensated by the more effective utilisation of the better lands; for these better lands will now be tilled by better paid men, and well paid labour is more effective than badly paid labour.

Allow me here to quote a short extract on the advantage of high wages.

"But high wages are not only a sign of progress, they are also a factor of progress, and this in three ways:—

1. When the labourer is well paid he becomes more intelligent and skilful, more self-respecting, a better man all round. I do not mean that wherever the labourer is poorly paid he is dull, unskilful, immoral, and that wherever he is highly paid he is all that he ought to be; for many agencies go to the making of character besides the rate of wages. But I mean this: that, given any labourer of the character that he is, however produced, higher wages will make him better, not worse--more efficient, not less.

2. High wages induce clever men to invent, and compel slow men to adopt labour-saving contrivances of all sorts, and so add to the productiveness of labour. Employers do not bother themselves about inventions where labour is dirt cheap. In the making of the Suez Canal, the sand was excavated with common hoes, and carried out on women's heads, though steam excavators and elevators were well known, and would have saved nine-tenths of the labour. But the labour wasn't worth saving—to the contractors. Improved appliances in agriculture are in much more general use in America and Australia, where wages are high, and because they are high, than in England; and more in use in England than on the Continent, for similar reasons.

3. High wages, like free-trade, help to weed out weak industries, and to concentrate labour where it is most effective, as already pointed out." *

It may be said again that the increased price referred to of goods consumed only by the upper classes will diminish the consumption, and that to that extent the labourer will fail to shift the burden of his increased wages on to the rich consumer. Granted. But the effect of this would merely be to diminish the successfulness of strikes, and the question before us is simply whether strikes *when they are successful* can really improve the labourer's position. I have tried to show that they can. It is for the present company to decide for themselves whether I have succeeded.

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* Extract of a paper, "Land Nationalisation," by the author (reprinted by permission), from the Co-operative Wholesale Societies' Annual, 1890, and issued by the Land Nationalisation Society: Manchester, 1890.

GENERAL INCREASE OF WAGES FALLS UPON CONSUMERS OF PRODUCTS, AND IN NO WAY ENCROACHES UPON RENT OR PROFITS OF CAPITALISTS.

By R. M. Johnston, F.L.S.

Different observers standing at different points of view in the midst of many complex problems are hardly ever likely to concur in each others conclusions if their respective views are limited to a few isolated facts, belonging to but still forming an insignificant part of the whole series of facts upon which the true solution of the complex problem depends. Each observer under such conditions may arrive at opposite conclusions, which may be perfectly consistent with the fragmentary data upon which they respectively rest, and yet be altogether wrong and inconsistent when correlated with the more important series of *co-efficients* which were overlooked or ignored.

The conclusions of even the most extended observations may also be consistent with the data upon which they are based, and yet be altogether inconsistent with the truth, if the data themselves be inaccurate. Further, there are always some points so difficult of solution that only the powerful restraint of a particular habit of mind or training can prevent ones sympathetic leanings from leaping the gap to the goal desired in preference to the wiser course of making further exploration or waiting for further gleams of light.

These observations are necessary when called upon to review the arguments of Mr. Ogilvy, in so far as they are supposed to touch upon my former paper on Strikes and their Influence upon Wages. It affords me great pleasure to find myself in agreement on so many points with one like Mr. Ogilvy, whose well-known generous sympathies for the amelioration of the condition of the masses of the people must command the respect of all right thinking persons. We are substantially in agreement in the view stated by me in my former paper, that "A strike may be the means of successfully raising the status of some branches of labour that are comparatively under-paid or over-worked; it may raise the *real wages* of a particular country or locality which formerly laboured under the average remuneration of other countries; it may be the means of forcing the capitalist or employer to give a fairer or larger share of the profits of capital and labour—*i.e.*, machinery, plant, skill, and labour—but from the very nature of the common source of all profit and wages, viz., the current products created by the combined services of capital (instruments) and labour, strikes cannot raise the real wage of *all* wage-earners."

In other words, it is possible to regulate and alter the distribution of the aggregate wealth of consumable necessaries by means of strikes.

So far there is a substantial agreement between us.

It is in the following statement made by me wherein our views are in diametrical opposition, viz.:—(1.) "It is not denied that an arbitrary increase to *nominal wages*, if restricted to a few industries, might increase both *nominal* and *real* wages of these trades; but in all such cases it would be obtained by a *proportionate decrease of the purchasing powers or real wages of every other class in the community who were obliged to purchase the products enhanced in price of the various industries who succeeded in having the nominal wages so raised*," and more especially is the fundamental difference between us set forth in the next paragraph used by me, viz.:—(2.) "It is the *consumers of products or services who would ultimately lose* by the advantage gained by the industries whose wages were nominally raised, *and not the capitalists and employers as such who directly were obliged to advance the nominal wages*." And again, we are diametrically opposed in relation to the following observations of Mr. Gunton's, with which I am completely in accord. (3) "That nothing can improve the social condition *of the masses*, whether it raises the nominal wages or not, *which does not increase the general rate of real wages* (*i.e.*, purchasing power) *the degree of which may be universally taken as the accurate measure of social progress*," and "there are no economic means by which the material condition of the masses can be improved which do not tend to increase the aggregate production of wealth per capita." And these differences between us—as regards the means by which alone the condition of the masses can be improved—are finally summarised by me in the statement: "Invention, increasing command over the forces of nature, can alone accomplish this. Schemes of distribution and strikes for higher nominal wages must end in failure and disappointment, so far as *the great masses of men are concerned*."

In opposition to these three statements Mr. Ogilvy makes the following observations, to all of which I am sorry to give a categorical No!

(1) That "No increase of production can improve the condition of the masses unless accompanied by an increase of nominal wages."

(2) "In the primary industries, that is those concerned in extracting or producing the raw materials of wealth from the land (as in agriculture and mining), every increase of wages *will come out of the rent*;" and again, "Every department of industry (including carriers by sea and land) which is

concerned in supplying the raw material of wealth from the land, every enforced rise of wages will be clear gain to the labourer, because the loss will fall upon the landlord, *and stay there.*"

It is remarkable that Mr. Ogilvy's usual penetration should in these two propositions have so far failed him that he did not perceive that their support wholly rests upon old economic fallacies long since exploded, and discountenanced by the best, if not nearly all, modern economists. Even Mr. Henry George does not support these old economic fallacies, associated with "The Theory of Rent" and "The Wages Fund;" and yet, notwithstanding this, Mr. Ogilvy's conclusions regarding rent and wages depend wholly for support upon the resusicitation of those old fallacies which so long darkened men's minds regarding the true theory of rent, and the true relations between rent, profit, wages, production, and prices.

THEORY OF RENT.

"Ricardo's Law of Rent," now almost universally accepted by economists, is so well established by reason and experience that even Mr. Henry George is forced to admit that "its mere statement has all the force of a self-evident proposition." It is thus set forth, according to Ricardo:—

"*The rent of land is determined by the excess of its produce over that which the same application can secure from the least productive land in use.*"

Or, as stated more specifically by Mr. F. A. Walker:—

"*The rent of any piece of land is determined by the difference between its annual yield and that of the least productive land actually cultivated for the supply of the same market, under equal application of labour and capital.*" (P. 197, "Political Economy," London, 1887.)

If this be granted, we have the following distinguishing elements:—

Let R = Excess of Produce over that of the least Productive land actually cultivated for the supply of the same market under equal applications of Labour and Capital = Rent.

N = Produce of the least productive land actually cultivated under similar conditions to R.

C = Profit of Farmer and Capitalist.

W = Nominal Wages of Labourer.

P = Produce of Land, Labour, and Capital.

D = Demand of Consumers.

D^m = Maximum Purchasing Power of Consumer.

D^n = Minimum Purchasing Power of Consumer.

P^{rm}=Maximum Nominal Price of Products.

P^{rn}=Minimum Nominal Price of Products.

Then $R+N=P$ or Supply

$$\frac{C+W}{D^m}=P^{rm} \text{ or Price Maximum.}$$

$$\frac{C+W}{D^n}=P^{rn} \text{ or Price Minimum.}$$

Now it can be seen at once, if these premises be granted, that as the application or efforts of labour receive the same reward whether engaged upon the least (N), or most productive land in cultivation (R), that any alteration in the rate of wages, *if general,* would not affect the proportion falling to R, no matter whether the nominal wages rose or fell; for R (rent,) is solely determined by N, and—excepting cases where employment and area under cultivation are curtailed—is in no way concerned with the rate of wages. The *surplus, R* (*rent*), has not come into existence as the sole work of labour; for in relation to the laws which determine price it is a measure of the gift of nature monopolised in the hands of landowners as rent. It is the fluctuations of demand (D) which directly affect the value of products coming to R, and not the scale of wages, whether high or low, so long as the scale is general. As about 52 per cent. of the breadwinners in various countries depend upon agriculture and pastoral industries, it is also clear that if the increase of their wages was only local, or partial, the condition of the great mass of workers would not be improved.

Going back to our analysis it follows that

$$R + N = P \text{ or produce of land, labour, and capital or } = \text{Supply.}$$

Seeing that supply and demand are among the principal factors in determining price or nominal value in the market and as these are ever varying factors, it follows that nominal value or price ever fluctuates with the variations of (P) supply and demand (D). Thus—

$$\frac{R + N}{D} \text{ or } \frac{P}{D} = P^r \text{ or Price.}$$

But the actual cost of products being determined mainly by the cost of labour and machinery cannot fall below the actual aggregate cost of the standard of living for the labourer and the actual cost of maintaining the capitalist's machines and instruments.

On the other hand, the nominal value for products divided between $R + G + W$ cannot be increased *much above* the minimum producing cost without operating upon demand through the lowered purchasing power of the consumer, and so producing a check, or temporary equilibrium.

From this reasoning it follows that the surplus produce (R), while increasing the general store, and thus tending to lower prices to consumers, yet rent or earnings of landlords *per se* do not enter into the market price in any way, and therefore do not increase the price of products to consumer.

Therefore it follows that the ultimate exchange price, whether maximum or mimimum, is wholly determined thus:—

$$C + W \left\{ \begin{array}{l} + \ (D^{m} - D \\ - \ (D - D^{n} \end{array} \right\} = \left\{ \begin{array}{l} P^{rm} \\ P^{rn} \end{array} \right.$$

How, then, can any arbitrary increase or decrease of W affect R (rent), except in an indirect way, by its effect upon consumer, who certainly would have his real wages or purchasing power diminished correspondingly with any arbitrary increase to the *nominal wages* of W.

It can be shown, in a similar way, that the profit of the farmer, or entrepreneur, and the interest of Capitalists are determined solely by competition with each other, and are in no way affected by cost of machinery or wages of labour so long as these latter elements of cost are common to all competing farmers, entrepreneurs and capitalists. In all their enterprises *such charges* PLUS their own *profit* (solely determined by comparative skill, enterprise and competition) make up the final cost of products which *does not stay with the landlord or entrepreneurs,* but is passed on, and wholly borne by consumers; and therefore it is as *consumers* (not as landlords, farmers, entrepreneurs, capitalists or wage-earners) that all classes concerned in production are affected by any arbitrary increase to the nominal wages of the labourer.

These arguments, while demonstrating the accuracy of my original observation that "It is the *consumers* of *products or services* who would ultimately lose by the advantage gained by the industries whose wages were nominally raised, *and not the capitalists and employers* (as such) *who directly were obliged to advance the nominal wages,*" they also form a complete refutation of Mr. Ogilvy's opposing argument, tending to show that "*Every enforced rise of wages will be clear gain to the labourer, because the loss will fall upon the landlord, and stay there.*"

The fact that rent forms no part of the price of agricultural produce may startle many who have not given the matter deep consideration, and although affirmed by me as a truth, it must not be supposed that I take up a singular attitude in respect to this question: for it is the generally accepted opinion of the ablest economists and thinkers of the day. In proof of this I need only cite one witness, Mr. F. A. Walker, whose able work on Political Economy, published in

1887, deals so thoroughly with all vexed questions of this character. At page 200-201 ("Political Economy") he writes:—

"From the law of rent, as it has been stated, we deduce the very important conclusion that rent forms no part of the price of agricultural produce.

"No proposition which the political economist has occasion to announce is so startling, at the first hearing, as this; nor does any other contend against such persistent incredulity. And yet no proposition can be more clearly established."

Notwithstanding what has been said, it is quite possible, and has actually occurred recently to a large extent in England, that a rise of agricultural labourers' wages there, or what has the same effect, the opening up of large areas of more fertile land, as in America, or both together, may have the effect of throwing the poorer lands of any one place out of cultivation, and thus directly diminish the value of rent in that place. This is happening now, and for the last fifteen years in England, mainly by the influx of cheaper products from the distant vast plains of Dakota and other fertile areas of America. But what does this involve? Why, that for every 1,000 acres thrown out of crop cultivation, thereby diminishing rent, about 30 breadwinners, equal to 173 persons, are directly deprived of employment. This is the only way in which rent can be injuriously affected, but it is a process which is equally disastrous to the local agricultural labourer. It is also, on the other hand, advantageous to the consumer so long as these themselves do not form too large an element of the general population; for otherwise their cheapened foods of foreign creation might be more than counterbalanced by their diminished earnings as producers, and thus operate unfavourably upon their *purchasing power* or *real wages*.

But returning to the question of rent and price, it is clear, as affirmed by Mr. F. A. Walker, "That in the same market, at the same time, there is but one price for different equal portions of any (similar description) of commodity;" and "We have also seen that the normal price is fixed by the cost of producing *that portion of the supply* which is produced at the greatest disadvantage. Apply these principles to the case in hand. England does not raise all the wheat needed for the subsistence of her population (mainly mechanical and industrial). Besides cultivating the most fertile of her own fields she makes heavy draughts upon the United States, France, Egypt, Hungary, India, and the Black Sea region. For the wheat of all these countries, however, so far as it is of the same quality, *there is but one price*. That price is fixed by the cost of raising the million, say of bushels, which are raised at the greatest disadvantage, which means at the only spend it in purchasing goods and hiring services just as the upper class did. They will in short, to the extent of the transference, be employed by each other instead of by their old employers.

My time being limited, I have been obliged to state my case in broad outline, without going into details and qualifications, but there are one or two such qualifications, real or apparent, that we may have time to glance at.

1. There is of course a limit to the rise of wages. The labourer cannot earn more than his labour produces. But this limit is a long way off; what the labourer actually gets is a very small portion of what his labour really produces; and the question before us is not whether there is such a limit, or how far off it is, but whether strikes, as strikes, can under present circumstances really improve the labourer's condition or not.
2. It will be said that the fall of rent which we have predicted will throw some lands out of use, and so actually diminish the total production of wealth. That is to say, that land that now yields current wages to labourers, and profit to employers, but only a small surplus for rent, will then yield no rent at all; in which case the landlord will withdraw such land from use and devote it to his own amusement, say for sport.

Well, that opens up a question about which you will hear more before long, viz.: the question whether a man who claims to be sovereign lord and master of a certain portion of the earth's surface shall be allowed deliberately to prohibit all productive industry on that area, to forbid willing labourers from working, and enterprising capitalists from investing merely because such enterprise will not yield blackmail to him, as well as profit and wages to the workers.

But passing that by, I would point out:

1. That a more equitable distribution of the produce of labour is a boon so great in itself as to be well worth some cost, and that we need not be dissatisfied because less luxuries are produced for the few very rich, if more comforts are provided for the many poor; not even though the loss in value on the luxuries exceeds the gain in value on the comforts.
2. That it is only the very worst lands that will be withdrawn, and the loss through the withdrawal of these worst lands will be more than compensated by the more effective utilisation of the better lands; for these better lands will now be tilled by better paid men, and well paid labour is more effective than badly paid labour.

Allow me here to quote a short extract on the advantage of high wages.

"But high wages are not only a sign of progress, they are also a factor of progress, and this in three ways:—

1. When the labourer is well paid he becomes more intelligent and skilful, more self-respecting, a better man all round. I do not mean that wherever the labourer is poorly paid he is dull, unskilful, immoral, and that wherever he is highly paid he is all that he ought to be; for many agencies go to the making of character besides the rate of wages. But I mean this: that, given any labourer of the character that he is, however produced, higher wages will make him better, not worse--more efficient, not less.

2. High wages induce clever men to invent, and compel slow men to adopt labour-saving contrivances of all sorts, and so add to the productiveness of labour. Employers do not bother themselves about inventions where labour is dirt cheap. In the making of the Suez Canal, the sand was excavated with common hoes, and carried out on women's heads, though steam excavators and elevators were well known, and would have saved nine-tenths of the labour. But the labour wasn't worth saving—to the contractors. Improved appliances in agriculture are in much more general use in America and Australia, where wages are high, and because they are high, than in England; and more in use in England than on the Continent, for similar reasons.

3. High wages, like free-trade, help to weed out weak industries, and to concentrate labour where it is most effective, as already pointed out." *

It may be said again that the increased price referred to of goods consumed only by the upper classes will diminish the consumption, and that to that extent the labourer will fail to shift the burden of his increased wages on to the rich consumer. Granted. But the effect of this would merely be to diminish the successfulness of strikes, and the question before us is simply whether strikes *when they are successful* can really improve the labourer's position. I have tried to show that they can. It is for the present company to decide for themselves whether I have succeeded.

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* Extract of a paper, "Land Nationalisation," by the author (reprinted by permission), from the Co-operative Wholesale Societies' Annual, 1890, and issued by the Land Nationalisation Society: Manchester, 1890.

greatest distance, viz., on the plains of Dakota." Wheat may be raised in Middlesex at an actual cost not exceeding two shillings per bushel; but the Middlesex farmer will not, on that account, sell his wheat below the market price, say six shillings (four shillings), which price is fixed, as we have seen, by the wheat from America. The difference, four shillings (two shillings?) is to be profit for somebody; and we will now proceed to show * that this body must be either the landlord or the tenant, not the agricultural labourer, and not the consumer of flour."

* As he afterwards does—p. 202.

To give a more explicit illustration of the probable effects of an increase in nominal rate of wages and of the process by which any increase in wages must fall upon consumers, and not upon rent of landlord, or the profit of the capitalist or entrepreneur—the following table is drawn up. And to throw further light upon the matter, let the points be discussed as if in diaologue between three persons, representing —landlord, builder and workman.

INCOME AND HOUSE RENT BEFORE AND AFTER A 20 PER CENT. RISE OF WAGES AND COST OF MATERIALS IN BUILDING TRADE.

—	Before Rise.			After Rise.			Amount of Net Increase or Decrease.		Per cent. Net Increase or Decrease.		Percentage.
—	Gross Income	Annual House Rent.	Income less Rent	Gross Income.	Annual House Rent.	Income less Rent.	Upon Income less Rent. Increase.	Upon Income less Rent. Decrease.	Upon Income less Rent. Increase.	Upon Income less Rent. Decrease.	Actual Increase to House Rent.†
	£	£	£	£	£	£	£	£	P.C.	P.C.	—
Landlord‡	1,000	110	890	1,000	130	870	—	20	—	2·25	18·2
Building Contractor‡	500	85	415	500	100	400	—	15	—	3·0	17·6
Mason*	*125	*35	*90	*150	*40	*110	*20	—	*22·2	—	*14·3
Butcher‡	110	25	85	110	28	82	—	3	—	3·53	12·
Tailor‡	102	20	82	102	22	80	—	2	—	2·44	10·
Labourer‡, (not Builders'.)	90	18	72	90	20	70	—	2	—	2·77	11·1

† The land element of value in house rent is assumed as if not affected by rise in the wages and cost of materials in building trade, and therefore it does not show 20 per cent. increase on gross rental.

* Indicates the effect upon one of those who benefited by the rise in wages.

‡ Indicates the effect upon others.

Let us, then, suppose—as indicated in the preceding table—that all persons whose services are necessary to complete the building of dwelling houses (from the quarryman to the house painter and glazier) succeeded by a strike in having their wages or services raised 20 per cent. The question at issue between Mr. Ogilvy and myself is involved in the query:—Out of whose pockets would this 20 per cent. be derived?

Mr. Ogilvy adopts the view that it would come out of the pocket of the *capitalist* or *employer*; and I from a considerable practical experience in the building and letting of houses, gained during five years in a large city, affirm that it comes out of neither *employers nor wage-earners* as such, but out of the pockets of all persons who inhabit houses, *i.e.*, the *consumers* of houses so to speak. For let us take an instance of the process whereby the 20 per cent. increase ultimately comes to fall upon the *consumers of houses*, whether rich or poor, employer or employed, as it is attempted to be shown in the following imaginary dialogue between the three persons already referred to.

DIALOGUE BETWEEN LANDLORD AND BUILDER.

A.—*Capitalist*, a landlord of houses, deriving his income from investing his money in houses.

B.—*Employer*, a building contractor, who derives his income from his capital and plant and his directing skill as a builder and organiser.

A.—My dear *B*, I propose to build four additional dwelling-houses, similar to the four which you built for me for £1,600 two years ago: 1 at £500, 2 at £400, and 1 at £300; and I shall be obliged if you will give me an estimate of what you will now build four similar houses for me in the same locality.

B.—I shall be happy to do so, but you must be prepared to pay a higher price, as all building trade wages and materials have now gone up 20 per cent.

A.—What? Do you mean to infer that I can afford to pay the extra 20 per cent. out of my pocket when my average profit hitherto at the old rates only yields me 5 per cent. on capital outlay in buildings, repairs, taxes and other necessary expenses in connection with letting, etc.? It is impossible!

B.—Well, there is no help for it. If you won't build others will; for as the population increase is not likely to be greatly affected for any length of time by the rise in the wages and materials of the building trade, more houses must be built by some one or other.

A.—That is all very true, but how can landlords afford to build houses at such prices at the old scale of rental?

B.—Rental of buildings, not land rent, in all times and places, you are surely well enough aware, is determined by current rates and prices of land, labour, and materials, and not upon old rates of rental. You are no more called upon to let your houses at the old rates of rental than I am to contract for the building of houses at the old contract prices. In my profession we base our estimates of costs, not upon the old rates, but upon what we infer the rates of wages, money, and materials will be on the average during the *time* and at the *place* where the new contract is to be carried out; and if you are to survive as a successful landlord you will have to be guided by the same unavoidable commercial principles.

A.—But that would only be done by making a corresponding increase in the rents of houses?

B.—Certainly. If competition hitherto among landlords obliged them to restrict their profits to 5 per cent. on capital outlay, the altered conditions of the labour market *affect them all alike*, so that all who do not become bankrupt must earn the same profit which competition among landlords themselves determined as a safe working minimum profit long before the recent rise of wages and materials came about. That means that rental of houses must bear the extra cost of building. Rents must be raised. The occupiers of houses must inevitably bear the burden of the increase, and as both you and I occupy houses we must also pay additional rent as occupiers of houses. But although we do expend more of our income as occupiers (*i.e.*, consumers) of houses, that cannot affect our income as derived from our business concerns as landlord and builder.

A.—Why so?

B.—Because the profits of either are determined, not by the wages, high or low, paid to workmen under them, *so long as they are general*, but upon the intensity of competition between employer and capitalist, and other employers or capitalists in the same business.

A.—But the workmen think that their higher rate of wages comes out of the "Wages Fund" of the older economists, and this is one of the reasons why they are so bitter against the employers or capitalists for absorbing, as they think, a too great share of the joint produce of labour and capital.

B.—The older economists are largely to blame for the present hostile attitude between the employer and his workmen; for undoubtedly this attitude is, in a great measure, based upon the mistaken notion that the increase in wages is an encroachment upon the employer's share of profit; whereas it is in reality an additional charge on the values of products affected, which is ultimately borne by the *consumers* of the particular products.

A.—But will the workmen be satisfied if they comprehend this matter in the light in which you regard it.

B.—Why should they complain? They have got their 20 per cent. increase. But if you are anxious to ascertain their views let us put the matter to the test by asking Jones the

Hewer, one of the most intelligent of my workmen, who is now approaching us.

A.—Good-day, Jones, I suppose you feel satisfied with the results of your strike contest, which has terminated so favourably for the workmen in your trade.

Jones.—Ah, sir! we are glad to have scored a success, but it has been at a bitter cost to all of us.

A.—But surely with 20 per cent. increase to your wages you ought to be fairly well satisfied.

Jones.—Oh, that's true enough, so far as the rate of wages is concerned, but trade is now in a very depressed state, and as a consequence many of our brother workmen are but half employed, and even if we were all fully employed at the better wages now ruling it would take fully ten months to cover our losses due to enforced idleness during the long bitter strike of nine weeks, which brought us all so much distress and misery.

A.—Ten months do you say?

Jones.—Yes, fully that, without mentioning the increased cost of living, now that the landlords are about to raise our rents by about £6 a year.

A.—I should like to hear how you account for your loss being so great that it should take so long a time at the present higher wages to cover it.

Jones—Oh, that's easily proved. Our nine weeks' idleness caused us a direct loss of £20 12s. 6d., reckoned at our old rate of 8s. 4d. a day, for 44 hours in the week. Our present wages are higher by 1s. 8d. a day (*viz.* 10s.), and it is easily reckoned that it will take 247½ days of that increase to make it good; and as we can only reckon 300 working days in the year it means the better part of ten months' earnings to put us straight.

A.—How do you account for so many of your men being still only half employed?

Jones.—Well, you see, the higher rents asked for the better class of houses are driving the poorer classes into the inferior houses that were formerly empty, and there is less demand than usual for new houses in consequence.

B.—Jones is quite correct there, as I know to my cost; for I have not had a third of the contracts this year, as compared with the average of the last three years, and my experience is also the experience of other builder contractors. But in my opinion there is another reason for the present slackness in the building trade.

A.—And what is that?

B.—I have long observed that statisticians are quite right in their statement that a sudden increase, however caused, in the cost of living, has an immediate effect in checking, or, rather, postponing marriages; and in no trade has this effect so immediately a depressing influence as upon the building trade.

A.—But things will take their natural course in time.

B.—True, but in the meantime our trade, whether for workmen or employers, suffers, and, as Jones has said, it will take a long time for the better state of things, when they do come about, to make good the losses of the present year of enforced idleness and its evil consequences to both employers and workmen. Employers now see, when it is too late, that it would have been better for employers and workmen had they approached each other at the outset of the strike in a more friendly way, instead of fighting it out to the bitter end of a nine weeks' struggle.

Jones.—I say aye to that, too.

A.—Then you, Jones, also think it was a mistake to enter upon this strike without a serious attempt to gain your cause by a more reasonable course?

Jones.—Aye, sir, I do, and I have always been of the opinion that it would have been better to have settled our dispute by a friendly conference, even if it were to end in a compromise, rather than strike first and be obliged to confer when we were embittered by a long and cruel struggle for victory.

A.—And why, then, was the strike originated so suddenly without an earnest attempt to settle matters by a friendly council of conciliation?

Jones.—Why? You well enough know that the thoughtless, and those not burdened with the cares of a family, form the majority of workmen, and these are always too eager to enter a conflict without counting the bitter cost.

B.—The workmen are not singular in this respect, for the majority of employers at the outset were also too anxious to precipitate a conflict without proper consideration, and are also much to blame in their eagerness to fight out the struggle rather than compromise or make any honest attempt to approach the settlement of differences of opinion by conciliatory conferences. I, too, am comforted with the feeling that, although one of the minority of my class, I used all the influence I could exert to promote a friendly conference at the first; but, as in Jones' experience, I and those who acted with me were over-ruled by the majority, who were too eager for conflict to give the matter the consideration that was necessary.

A.—Then both of you think that the strike might have been avoided with advantage to all?

B.—Yes, I think so. We could have arrived at the same result had we discussed the matter fairly at the outset.

Jones.—I am sure we could if the same arguments on both sides were considered at the beginning of the dispute, and if we had an opportunity to discuss on even terms our misunderstandings of each other.

A.—Then both of you are of opinion that all future struggles of this kind in the various industries will be settled by friendly conferences rather than by lockouts or strikes.

B.—I fear not. The majority of men only see that the strike effected a rise of wages; and that will induce other trades to follow their evil example. The misery of the thing they do not consider. Nor do they perceive that the raising of wages if made general would cancel all the advantages gained by the first few industries who reaped the advantages of the wages increase; for the nominal increase in cost of living would then actually counteract all the advantages obtained by nominal increases to income.

A.—You have stated that before, but I confess I do not quite see how such a result comes about.

B.—It is, however, a matter the truth of which can easily be demonstrated by a simple process of reasoning, and I will try to make it clear to you. First let me assume, according to the modern course of exchange, that no element of the gratuitous gifts of nature, as such, enters into nominal values of products, and therefore the final nominal cost of all products and marketable satisfactions to consumers is solely determined or made up from the aggregate nominal cost of all the services engaged in the work of producing them. In this way it is obvious that the aggregate nominal value of all *wealth in exchange* or satisfactions would be exactly identical in nominal value to the nominal earnings of all persons engaged in producing them, whatever the nature of the services may be; whether organising and directing skill, wealth producing instruments, or the simple physical power of human bone or muscle. Any addition, therefore, to the nominal cost of production must correspondingly increase the aggregate nominal cost of products.

A.—I can follow you so far, although I confess I am not able to see as yet why the gratuitous gifts of nature should not be monopolised by some, and in this way come to be a charge upon products to consumers, without forming an item of expenditure of energy or capital on the part of the producer.

B.—Your observation is a very important one; for although upon another occasion I may discuss this point with you, I must ask you for the present to take it for granted, as an assumption on my part, the truth of which may afterwards be discussed on its own merits.*

A.—Well, let us for the present admit this important assumption on your part, it still remains to be proved that no benefits would accrue to wage-earners if the nominal incomes of all the services of breadwinners, were equally increased.

B.—Yes, that is the point I desire to prove. But you must also bear in mind that it is the mere raising of the nominal rates of wages or incomes I refer to; for if by raising the rate of wages we could also correspondingly increase the number or actual quantity of products, my argument would completely fall to the ground.

A.—Yes, I perceive this, but I cannot myself see any indication of increased energy on the part of the great body of workmen who have had their wages raised.

B.—I am glad you admit this, for I can assure that so far as my business is concerned the amount of work performed per hour per man upon the whole remains unchanged.

A.—May not, however, the indirect effects of the improved condition of your workmen—giving them greater opportunities for self-improvement and greater power to improve the education of their children—result indirectly in promoting the spread of a higher culture and intelligence, and by this means increase the agencies at work which promote invention and discovery, and so multiply man's power over natural forces. For if this should be the outcome, our experience in the past shows that the satisfactions of life might be increased indefinitely without an additional tax upon the labourer's physical efforts or time, and without a very much larger expenditure of his income towards labour-saving instruments.

B.—I do not deny that something of this may be expected, providing the rise in wages is not general; but under any circumstances it must be infinitesimal; for *invention and discovery* spring from the *individual mind*, and have very little to do with the material condition of the individual, or a more comfortable state of life. The phrase, "Necessity is the mother of invention," has not come to be quoted as a world-wide phrase without some broad show of reason and truth; and this certainly does not encourage us in expecting a larger crop of inventors or discoverers from those whose condition has become more comfortable.

A.—This may be true, but surely you must admit that a greater spread of intelligence must broaden the sources from which inventive genius springs.

B.—Again, I repeat that I do not deny that this may have some influence; but I fear the mere attainment of a more

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*See *Monopoly of the Gifts of Nature* ("Root Matters"—First series, pp. 31, 32).

comfortable state of existence among a section of our industrial classes would in itself have an infinitesimal influence upon invention, discovery, and increased energy. The new idea springs from the single mind, and not from the society or aggregate.

> " Men perished in winter winds till *one* smote fire . . .
> They gorged on flesh tell *one* sowed corn . . .
> They mowed and babbled till some tongue struck speech.
> What good gift have my brothers, but it came from
> Search, and strife, and loving sacrifice."

Professor Hearn had a clear perception of the conditions which determine invention when he wrote the following words :— *

"At every time and in every place the master of all arts and the bounteous bestower of genius is Want. It quickens the perception and sharpens the power of contrivance. This action is felt in every part of industry. There is scarcely one of the great improvements in the arts which has not immediately been connected with the expansion of some want. The want may be caused by the natural development of the capacities of the person by whom it is felt, or by the presence of some external obstacle. But whatever may be its origin, or whatever form it may assume, there is always a want, and a want of considerable persistence and intensity."

It was to strikes among workmen and the dearness or scarcity of skilled labour in America and in other countries that we mainly owe the origin of many ingenious labour-saving instruments, such as the cotton gin, the reaper and binder, and sewing machines. It was the craving for more leisure to play or scrog which led the boy Humphrey Potter to discover the first method for making the steam engine self-acting.

A.—It seems to me that the logic of your argument is to undervalue the results arising from improvements in the material condition of the people, and to magnify the influence of difficulties, obstacles, and want.

B.—You are no doubt in one sense justified in making this observation; but remember it is restricted by me to the following questions :—What are the potent influences in promoting useful invention or discovery? Do they spring more freely from men's minds when their material conditions are improved, or are they originated more frequently under the pressure of wants and difficulties. My own opinion tends to the conviction that the latter are the more potent influences.

In closing this imaginary dialogue, which might be greatly extended with advantage, let me now touch upon the question raised by Mr. Ogilvy as regards the relative personal consumption of wealth by rich and poor respectively.

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* P. 194. Plutology.—Extent of Invention—Circumstances which determine it.

PERSONAL CONSUMPTION OF COMMODITIES BY THE RICH.

It is evident that Mr. Ogilvy had not bestowed his usual care upon the question concerning commodities consumed respectively by rich and poor, whether luxuries or necessaries. He has taken a very strange course in forming an opinion of the relative amount of consumption of goods by rich and poor from a superficial impression made on his mind by the showy displays seen in shop windows.

Rich articles are more fitted for attractive display as advertisments, but only the inattentive, or the unskilled, would ever dream of estimating, upon such evidence, the relative quantities and the relative aggregate values of goods held in stock for sale intended for the rich and poor respectively.

Although the gorgeous silks, satins, velvets, ribbons, and dress goods form the chief displays in the windows of establishments devoted to the sale of textile fabrics generally, they certainly form an infinitesimal part of the value, and a still more infinitesimal part of the weight of the general stock on shelves and in warehouses. This stands to reason; for it is well ascertained that all persons receiving upwards of £150 per annum—*i.e.*, under the annual average income of the skilled mechanic—only form about 2·28 per cent of the total population even in rich England. But a better plan would be to ascertain the value of these luxurious silks, satins, etc., as determined by the imports of a country whose principal supplies of textile fabrics come from foreign sources. Victoria is such a country, and an analysis of that colony's imports shows that scarcely 7 per cent. of the value of textile fabrics and dress are represented by the richer articles, such as silks, satins, ribbons, velvets, dress goods, and scarcely 1 per cent. of the weight of materials.

As regards *Food*, certainly not more than 5 per cent. can be set down as consumed by the rich personally, although their expenditure would be a little more than this if the consumption of their boarded servants were by error allowed to be included.

As regards *Luxuries*, again, it is remarkable that although we gave to all persons over £150 income the whole of luxurious articles imported represented by works of art, paintings, musical instruments, jewellery, and plated-ware, etc., it would not represent more than 7 per cent. of what the masses alone consume of *luxuries*, in the shape of drink and tobacco.

Again, as regards the consumption of the fruits of labour connected with the building trades, it is well to bear in mind that 64 per cent. of the value and 92 per cent. of the number of all *dwelling houses* in Great Britain are connected with those (certainly not the rich) living in houses under £30 annual rental.

Although the nominal incomes of the rich appear to absorb a far greater proportion of the aggregate nominal earnings than their proportional numbers as units of the population, yet it must be borne in mind that a reference to the mere nominal incomes is a most deceptive guide as regards the individual consumption of the rich; for in the latter are aggregated much of the incomes of vast numbers of professional classes and domestic servants, which, being reckoned again and again as distinct incomes, although derived chiefly from the expenditure of the rich, make the nominal aggregate of the income of the rich and of total income enormously above the true net income of both the rich and the national aggregate. That is, the real incomes of *individuals* are counted over and over again, and thus falsify the true proportions of net personal income coming to rich and poor respectively.

In opposition to Mr. Ogilvy's statement, then, I may confidently repeat part of what I have already dealt with more fully in a former chapter of "Root Matters in Social and Economic Problems" regarding

DISTRIBUTION AND CONSUMPTION OF WEALTH.

Under this heading I have observed, "There are many fallacies current with respect to the creation and distribution of wealth. If all the enormous wealth year by year created by (1), stored fruits of previous labour (Capital—of which steam engines alone represent approximately the work of 1,000,000,000 men, or more than the physical energy devoted to the creation of fresh wealth, than double the working population of the earth), (2), current labour, and (3), the gratuitous forces of nature, were directly devoted to consumption or enjoyment, no doubt the proportion per head alloted to the industrial labourer would be small indeed in comparison with the rich."

But the human body, whether rich or poor, can only consume or assimilate a certain quantity of food per day. The old, sickly, and very young, cannot consume or assimilate as much as the strong healthy persons of youth and prime of life. Health and hard physical labour cause the body to burn more food, and the greater tear and waste consumes more weight of the products of the sheep and cotton plant just for the same reason as greater energy exhausted by a steam engine demands a much higher consumption of fuel and a much greater waste of parts in tear and wear.

From this reasoning it is almost conclusive that a strong healthy navvy can and does consume more weight of the products of the soil, of the flour mill and the weaver's loom, than the less robust city clerk or the brain worried financier; the mere quality or rarity of the materials involving more cost in some of the materials of the rich is comparatively insignificant and involves no more tax on the soil, on the capitalist's machines, nor on the workman's labour.

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What is usually termed "The enormous accumulations of wealth in our times," "The riches of capitalists," do not consist of fine houses, luxurious equipages, money or grand parks, or if so, it only forms a most insignificant portion of it. The great bulk of the nominal and real wealth of capitalists consists of land improvements, mines, railways, tramways, ships, canals, stores, warehouses, manufactories, machines, tools and instruments, etc., themselves; and though rightly included in the aggregate wealth of a country by statisticians, these do not in any sense enter into the *personal consumption* of the rich owner any more than they enter into the personal consumption of the workman engaged in connection with these forms of national wealth.

THE FRUITS OF LABOUR.

Familiar phrases, such as "The fruits of labour," "The toiling masses," "Man shall live by the sweat of his brow," "Capital is the fruit of labour," and such like, though correct enough as pleasing figures of speech, are too often wrested from their proper uses to adorn the fallacious arguments or rhetorical displays of well meaning, kind hearted people, in whom the logical faculty too often is easily overborne by sentiment. Although I have a high appreciation of Mr. Ogilvy's logical acumen, I cannot help feeling that his enthusiasm and kind heart have, for the moment, dominated over his logical faculties when he spoke "of the lower ten millions whose toil is the *active factor that produces all wealth*, not of the upper ten thousand who *in some mysterious way* manage to get rich upon that toil." I am not disposed to quarrel with these words in so far as they convey the idea that their services (whether functional as accumulators of capital energy, or organising energy as entrepreneurs—man for man), absorb a very much larger share of the aggregate satisfactions produced than is ideally just or desirable. But this objection is merely one of degree, and is applicable to all persons between the earnings of the poor city girl of London, who has to wearily "stich, stitch" for dear life for 1s. a day, and the colossal earnings of a Vanderbilt. The following table may help to convey an idea how far *privilege* permeates throughout the whole range of human services, so far as *reward* bears any relation to either *time* or the amount of *muscular* energy expended:—

EARNINGS.

—	Average per day.		Per cent. Increase.	Average of Rich and Poor per day.			
				Above.		Below.	
	s.	d.		s.	d.	s.	d.
1. London Seamstress	1	0	—	—		4	6
2. English Agricultural Labourer...	2	0	100	—		3	6
3. Australian Labourer	6	0	200	0	6	—	
4. Australian Carpenter	12	0	100	6	6	—	
5. Average of the Rich Classes in England 3·3 per cent	40	0	233	35	6	—	
6. Average of Rich and Poor ...	5	6	—	—		—	

This proves that the total income of rich and poor—in one of the richest countries of the world (United Kingdom, £1,250,000,000)—only averages 5s. 6d. per day per bread-winner, and that all those who earn over that rate per day really belong to the "privileged classes;" for even the common labourer of Australia at 6s. per day receives 9 per cent. above the *level of equality*, which, if once attained, so many vainly dream would procure them a vast addition to their present allotted share in the distribution of wealth. The Australasian carpenter actually receives a higher relative rate of income (not a greater absolute difference, however,) above the London seamstress (viz., 1100 per cent.) than is the average rate of the rich (3·3 per cent of population) above that of the Australasian carpenter—being only 233 per cent. higher.

It follows clearly from this that strikes for higher wages among those who already earn above the *standard level* of 5s. 6d. per day cannot justify their claims by the appeal indicated by Mr. Ogilvy that it "is a movement of the underpaid against the overpaid." It is not a fact. So far as the majority is concerned, it really would be a *movement of the overpaid against the underpaid*, or more specifically, it would be a movement of the lower grade of the privileged classes against the masses forming the unprivileged, *i.e.*, all those whose earnings are now below 5s. 6d. a day, or the standard level of equality. Nor can the lower grade of the privileged classes contend with justice that their higher wages are in proportion to greater expenditure of *time or muscular energy*. On the contrary it can be easily demonstrated that the lowly paid agricultural labourer or common lumper expends far more of his time and muscular energy than the better-paid carpenter, engine fitter, or mason.

Active Agents in the Production of Wealth.

Finally let us examine what truth there may be in Mr. Ogilvy's statement in which he leads us to infer that the "toil" of "the masses," "the lower 10 millions," alone "*is the active factor that produces all wealth.*" Entertaining such a view, it is not remarkable that Mr. Ogilvy should regard the riches of the "upper 10 thousand" as a hoard mysteriously and wrongfully abstracted from the forces actively engaged in producing wealth.

If by the toil of the masses he means that *all the physical forces* requisite to transport and transform natural materials to suit the needs of man, he is manifestly wrong. For (exclusive of the more gratuitous forces of nature, such as natural chemical changes, multiplication by the mysterious forces of life, sunlight and heat forces, gravitation, the rain, dew and the fertile soils, and the animal, vegetable, and mineral products in their natural state and position) there are the active forces set in motion—not of the expenditure of muscular energy—but of mental and moral force, exerted by men of forethought, of skill, of invention, and of the provident who designedly saved from immediate personal consumption and devoted such savings purposely to the construction of mechanical and other aids, devised or discovered by skilled minds, whereby the *forces of nature*, such as gravitation, chemistry, steam, water, wind, electricity, leverage, lower animals are so captured, tamed, and drilled, that they now exert a physical force in the production of man's wealth—whether in the way of transporting from place to place, or in transforming materials from the natural raw state to the highly finished—compared with which the *brute* *or muscular force* actually exerted by all the working men of the globe forms the most insignificant fraction.

I have already pointed out that it is estimated that the steam engines alone now engaged actively in the production of man's real and nominal wealth represent double the *potential muscular force of all men in the world* at the present time, exceeding the *muscular force of men actually engaged* in the production of man's wealth by, perhaps, three or four times. The mere muscular pressure of a man, which, on his part, only exhausts his muscular energy by what would be equivalent to the movement of his body by one step, may, and in fact now incessantly does liberate and set in motion a transporting force in one machine equal to the combined total muscular force of from 200,000 to 500,000 men.

At the present moment on the railways of Pennsylvania, in America, *a single engine* conveys a load of 1,500 tons 29,927 miles in one year. It would, in a primitive stage, say by the strong African carriers of Stanley, take the mere muscular force of 465,360 men, carrying 60lb., and travelling at the rate of 12 miles per day, to accomplish the same work in the same time; and even though they only received wages at the rate of 1s. per day, it would cost £6,980,400; at 5s. per day it would cost £34,902,000. The single Pennsylvanian engine, however, carries the same load, viz., 1,500 tons, 29,927 miles within one year for the sum of £92,721, or ½d. per ton per mile. That is, a single modern locomotive exerts as much wealth-producing energy as could be effected by the whole muscular force of 465,360 strong men, and at $\frac{1}{376}$ of the nominal cost. Even if we went into refinements, and attempted to abstract the human *muscular energy* expended in the manufacture of the engine from raw materials, and the consumption of stores and materials consumed in the work, also partly the produce of the muscular force of man, it would be more than covered by the subtraction of the muscular energy of 600 men, leaving still to the credit of the single machine a balance of natural physical wealth-producing energy, *i.e.*, *non-muscular*, equivalent to the *muscular* energy expended of 464,960 powerful men during one year.

When in addition we think of the Spinning Jenny, the electric telegraph, the sewing machine, and the thousand complicated forms of machinery—such as the Naismith Polka Hammer, which by the slight pressure upon a handle a small boy can instantaneously pour 100 ton blows upon ductile masses of iron—we can have some faint conception of the immense mechanical and natural forces ever at work in civilised countries—outside of the muscular force exerted by man—and contributing its giant share of the physical agencies which give commercial value to man's wealth.* It is clear therefore that nothing can be further from the truth than the assumption by Mr. Ogilvy that the energy of "the lower ten millions" or the "masses" alone represent the active factor that produces all wealth.

The brains of man can alone be credited with invention and discovery, not his muscular power. It is to the accumulations of savings from personal consumption by the labourers of former times that we are indebted for the stores devoted to the construction of the powerful mechanical and other auxiliaries now engaged in aiding the current labour of men, and not, as falsely assumed, to the mere energy exerted by those who happen to be the labourers or workmen of the present moment.

The large body of the capitalists of to-day are, broadly speaking, really the natural descendants and inheritors of the *savings* of former workmen, who not merely *worked* but *saved;* and it is specially because of the *savings* of former workers that we have now a vast accumulation of *capital* invested in labour-saving appliances, and in works of permanent utility to all men, and not generally because those who *saved* were indebted to labour for their savings. All labourers in the past, as well as in the present, did or do not accumulate savings, and the descendants of those *who did not save* have no just claim to the capital or accumulated savings now largely in the possession of those who saved, or their natural descendants.

Of course the children of the former savers of capital are thereby now often raised above the social scale of their fathers. But this is natural; for it must not be forgotten that the affection and solicitude of parents for their children are ever the active motive forces which induce parents to sacrifice present personal gratification, and to save up in order that their children may enjoy a larger amount of the world's material satisfactions than their parents permitted themselves to afford out of the fruit of their own labours. Take away this powerful motive and you destroy the main source of the savings which make capital accumulation a possibility. Capital wealth, therefore, has not been wrongly abstracted from the labourer as such. It is a real addition to the world's power and wealth, solely built out of the savings of those who providently abstained from consuming at the time the whole of the fruits of the labour to which they were entitled, which otherwise would have been as much lost to the world as if it had been destroyed by fire.

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It is not because *nominal wages* are much higher to-day in Australasia than at the close of the sixteenth century in Europe that the present workman is so much better off in every way than his predecessor of three hundred years ago, but mainly because of the great increase of capital wealth invested in labour-saving appliances, whereby the annual wealth created for consumption and *real wages* or purchasing-power over wealth have so improved that the workman of Australia can, by the expenditure of 4½ days' labour, command a much larger share of the world's wealth or satisfactions than could be done by the accumulated savings of 40¼ days' labour amidst the dirt, discomfort, and almost enslaved condition of the labourer 300 years ago.

I think Mr. Ogilvy's objections to my former paper on strikes have been shown by these observations to be based upon assumptions which cannot be sustained when subjected to close scrutiny, and I can only re-affirm that it is by increase of *savings* properly applied in the creation of instruments which will still more greatly multiply the powers of man that any marked improvement to the condition of the masses can be successful. Without this the mere raising of wages can only benefit a few industries at the expense of the many.

Discussion.

Mr. Ogilvy said that Mr. Johnston had rather drifted into the ethics of the question, which were expressly excluded in his paper, and discussion confined to the question whether strikes, as a matter of fact, really improved the condition of the masses. He had tried to show that they did, and Mr. Johnston had tried to show that they did not. It was for the members to judge. Mr. Johnston had based his argument principally on the theory of Ricardo, but he differed with him in thinking that that authority had expressed the whole theory of rent. Although later economists had adopted it, the British Parliament had virtually repudiated the theory by the establishment of Land Courts in the Highlands of Scotland, and in Ireland, thus introducing an artificial element into what was held by some economists to be a natural law. In regard to what Mr. Johnston said about the rent forming a part of the price of agricultural produce, there were some farmers present, and he asked them if they had to pay twice as much as they now did for their labour could they afford to pay as much rent?

Mr. W. E. Shoobridge said that there were two points which occurred to his mind. One was that the actual amount of wages was not so much the question as that of facility of exchange. Mr. Johnston had pointed out in his original paper, and he agreed with him, that it was not the actual amount of wages paid that benefited the workman, but the satisfactions that could be procured by the results of the labour of the workman. Mr. Johnston had shown what was an undoubted fact, that owing to increased production the working man was able now to get better satisfaction of his wants with his wages than was the case a few years ago. He attributed the origin of strikes to the combination in the first place of capital, which ruled prices. Of late years, through the improved condition of labour, some of the labourers had been able to make savings which accumulated so that they could do for a certain time without actual labour. They were, therefore, to a certain extent capitalists, and by combining they had been able to demand their own terms. He thought that this was the secret of the source and success of all strikes. There was no question but that the product of individual labour had greatly increased, but the question was how this increased product was to be divided if it was the case that, owing to the combination of capital, the amount paid by the consumer was too great in proportion to the amount paid to the labourer. This was a difficult question, but he hoped that it would be settled in the future without resorting to such barbarous methods as strikes. He considered that the main question at issue was whether it was possible by the present appliances to produce a great deal more of the articles necessary for life and comfort than was produced previously; if so, by labourers having the means of getting a larger share in the products their condition would undoubtedly be improved.

NOTES ON A NEW TASMANIAN PLANT OF THE ORDER BURMANNIACEÆ.

By Baron Ferd. Von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

In the early part of November 1890 my attention was directed, by a letter from Mr. L. Rodway, of Hobart, to his discovery of a remarkable plant, parasitic on the extreme roots of Aster argophyllus, and from his notes it was evident that this plant would at all events be new for the records of the indigenous vegetation of Tasmania. But as the plant was of fugitive growth and deliquescent structure, no specimens were in the first instance secured or preserved. On my particular request the search was very patiently renewed with the result of one more specimen being procured, well developed, and another bearing an unexpanded flower. These arrived in a good state of preservation, being carefully packed between the fresh leaves of some tender grass. Much to my astonishment I perceived that this long hidden floral treasure was a species of Thismia, of which genus (in its widest sense) as yet some few species are known from southern continental Asia, Ceylon, the Sunda-Islands, New Guinea and tropical South America. On careful dissection the Tasmanian congener proved very distinct from all others. Thus, then, we became suddenly acquainted with a member of this otherwise intra-tropical genus from the remotest southern part of the Australian dominions, from whence indeed this would have been least expected; nevertheless, the order of Burmanniaceæ is represented by one species of the typical genus, namely Burmannia disticha, down to a very far southern position in New South Wales, and also just outside the tropics from Nepal, while another, B. biflora, advances northward to Virginia, and a species of Apteria, A. setacea, gains its northern boundary in Florida.

Before offering any further general observations, I shall detail descriptively the characteristics of the co-ordinal Tasmanian plant.

Thismia Rodwayi.

(Bagnisia Rodwayi, F.v.M., m.s.c.)

Stem to about two inches long, flexuous, colourless, like all other parts of the plant glabrous; leaves scattered, rudimentary bractlike, semilanceolar, acuminate, devoid of colour; flower solitary, terminal, of putrid odour, closely supported by a much shorter involucre of three appressed equidistant semilanceolar bracts; calyx about $\frac{2}{3}$ inch long, somewhat

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How restricted some parasites are in this respect is demonstrated in Tasmania and Victoria by the Cyttaria Gunnii, which never occurs on any other tree than Fagus Cunninghami, all other Cyttarias occurring also only on Beech-trees.

For Australian phytogeography the finding of a Thismia, not as might have been looked for in North-Eastern Australia, but in such an extreme extratropic isolation, is one of the most remarkable additions to our recent knowledge in this direction. But the discovery of this plant is also in other respects of special interest, because it shows that the genera Geomitra and Bagnisia should be united with Thismia, the merging of Geomitra into Bagnisia having already (1883) been advised by Bentham and Hooker, a view acted on by Engler in the "Pflanzen-Familien," 21 Lief. p. 48 (1888). Those who prefer smaller genera for systematic arrangements against more natural and more easily employed larger genera with subdivisions, might assign to our new plant even generic rank, then as Rodwaya, but such a separation would mainly rest on the reduction of three of the calyx-lobes to extreme minuteness, and on the coalescence of the tips of the longer calyx-lobes somewhat in the manner of the Southwellias within the otherwise far disallied genus Sterculia; in typical Thismia the lobes are perfectly disunited, much differing as regards form in various species, while in Bagnisia and Geomitra they are variously united. Adopting all these plants for one generic group, we would obtain chiefly chronologically the following arrangement, so far as the species are hitherto known; but their series will likely in the course of time receive considerable augmentation yet.

1. *Thismia Brunoniana;* Griffith in the transact. of the Linnean Soc. xix., 341-344 t. 39 (1844). Tenasserim.

2. *Thismia Gardneriana;* J. Hooker in Thwaites enum. plant. Zeylan. 325 (1864). Ceylon.

3. *Thismia Macahensis;* Bentham and J. Hooker, gen. plant. iii., 459 (1883) implied.

   Ophiomeris Macahensis; Miers in transact. Linn. Soc. xx., 374-379, t. 15 (1847). Rio de Janeiro.

   This and the closely allied O. Ignassuensis (Miers l.c.) have an obliquely bulging calyx, free stamens, bicaudulate-filaments and upwards converging anther-cells, so that the genus Ophiomeris, against the views of B. and H. might perhaps be kept up.

4. *Thismia hyalina;* Bentham and J. Hooker, gen. plant. iii., 459 (1883) implied.

   Myostoma hyalinum; Miers in transact., Linn. Soc. xxv., 474-475 t. 17 (1866). Organ-Mountains.

This again might generically be held apart on account of the disconnected stamens with free very thin filaments and sagitate anther-connective, particularly so, should no transits to these characters be discovered in any yet unknown species.

5. *Thismia clandestina;* Sarcosiphon clandestinum; Blume Mus. bot. Lugd. Batav. i., 65 t. xviii. (1849) Java.

Imperfectly known, and therefore the generic place doubtful.

6. *Thismia Neptunis;* Beccari, Malesia i., 251 t. xi. (1878). Sarawak.
7. *Thismia Aseroe;* Beccari, Malesia i., 252 t. x. (1878). Singapore.

To this stands evidently in closest relation the simultaneously described and figured Thismia ophiuris from Borneo.

8. *Thismia clavigera.* Geomitra clavigera; Beccari, Malaisia I, 251, t. x (1878). Sarawak.
9. *Thismia episcopalis;* Geomitra episcopalis; Beccari, Malaisia i., 250 t. xi. (1878). Mt. Mattan, Borneo.
10. *Thismia Rodwayi;* Derwent, Tasmania.

This is nearest allied to the next foregoing.

The constitution of the word Thismia, as dedicatory to the Phyto-Anatomist Th. Smith, was unfortunate, though the name is euphonious.

Soon after this was written, several more specimens of the Thismia were found by Mr. Rodway and kindly transmitted to me; they came from the lower portion of the eastern slope of Mount Wellington. He noticed the plant to grow also on the roots of Bedfordia, and he further ascertained that the unpleasant odour of the flower is only developed in the process of decay. Root ramified into few filiform somewhat carnulent divisions. Stem one, or when two stems occur, distant, sometimes very short. The three shorter lobes of the calyx exterior, but at about the same level as the longer lobes, which can be regarded as petaline. Anthers concealed through the introflexion of the staminal tube, whereby they are pressed against the inside of the calyx-tube, so that intervening of insects becomes necessary for passing the pollen on to the stigmas. Outer part of the anther-connective ending upwards in two deltoid denticles, much overreached by an exceedingly tender setule. Pollen grains whitish when moist, almost dimidiate globular. Ripe fruit as yet unknown.

ON NEW SPECIES OF TASMANIAN ARANIEDÆ.

By A. T. Urquhart,

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Fam. EPEIRIDÆ.

Gen. Epeira, Walck.

Epeira Mortoni, sp. nov. Plate. Fig. 1.

Femina.—Ceph. th., long, 4·8; broad, 4; facial index, 2. Abd., long, 10; broad, 6; legs, 1, 4, 2, 3 = 19, 14, 17·5, 10 mm.

Cephalothorax fulvus, greenish tinge, lake-brown reflections on cephalic part and lateral margins, fovea deeper shade; hairs white, silky, adpressed; slightly surpasses tibiæ of first leg in length; moderately depressed; pars cephalica depressedly convex, truncation visibly rounded, ocular eminence slight; lateral index equals two-thirds of facial; depth of *clypeus* scarcely equal to three-fourths diameter of an anterior centre eye; sides of pars thoracica well rounded; fovea large, sub-oval, longitudinal; caput and radial striæ slightly defined; profile-contour rises from thoracic junction at an angle of 30deg., slopes moderately across caput.

Fore and hind row of eyes tolerably and somewhat evenly recurved; fore-centrals of equal size; posterior, median-pair posited obliquely on dark, oval, prominent spots, separated by an interval equal to an eye's breadth and a half, scarcely their space and one-half from laterals; anterior centre eyes visibly more distant from each other than they are from hind pair, an interval rather exceeding their diameter; their space and a quarter from side eyes; laterals about one-third smaller than centrals, seated obliquely, more than half their radius apart, on separate tubercular eminences.

Legs fulvus, femora of two-first pairs reddish-brown, annuli reddish-fuscous; distal rings on femoral joints; central and apical on tibiæ and metatarsi; second half of tarsi shade off to dark brown; hairs dark, somewhat sparse; spines brown or black, numerous, irregular.

Palpi fulvus, fore-end of pars digitalis fuscous; hairs light; well spined; moderately long and slender.

Falces brownish-yellow, fangs dark; conical, vertical, flatly convex, length equals breadth of anterior row of eyes, their space visibly surpasses it.

Maxillæ fulvus, fuscous clouding; length perceptibly exceeds their breadth, much dilated at extremity, roundly pointed, inclined towards each other.

Labium darker than maxillæ; nearly as long as wide, conical.

Sturnum mahogany-brown, cordate, moderately developed eminences opposite coxæ.

Abdomen elongate-oviform, moderately convex above, sides steep, longitudinally wrinkled; base produced into two sub-conical elevations; deep lake-colour, with brownish penetrative tints, markings creamy-white; dorsal area displays two wide, sinuate, converging bands, extending from the rounded face of basal humps to second half of dorsum, enclosing a cunate area, where they are resolved into a series of more or less defined spots terminating at anus; side stripes broad, sinuate, compressed somewhat forwards, interrupted at the nearly free spots contiguous to base of humps; between the latter is a somewhat V-shaped mark, extremities dilated, central spot; this figure is followed by several more or less pronounced dots on median line of cunate area; the more strongly defined impressed spots occur on fore-half; anterior pair placed between humps, form a quadrilateral figure with second pair, longer than broad; latter pair included in the transverse line of four spots, which cause a constriction in each of the converging bands; central pair indent extremity of these bands, represent with second pair a trapezoid narrowest in front; lateral margins clouded with lake-black, display on superior line and interrupted border, resolved into spots; ventral shield, olive-green, passing into a brown on median line, margin, yellowish, elongate oval; *vulva* light greenish-yellow; wrinkled, sub-conical, prolonged into a remarkably long vermiform stylus, yellowish, two fore-thirds blackish, somewhat incrassated and depressed towards second half, sharply bent forwards, rapidly curved backwards; posterior face of corpus vulvæ displays a dark rimmed oval area, enclosed within is a fuscous plano-convex spot.

Var. a, *Cephalathorax* galbious, dorsum of caput and median band reddish brown, lateral margin fuscous. *Legs* galbious, femora of I. and II. suffused with brown-black, annuli broad, fuscous. Colouration of palpi lighter than legs. Pattern and colours of *abdomen* do not differ from type-form, except that the lake approximates more or less to a deep brownish-purple.

I have much pleasure in naming this handsome species after Mr. Alex. Morton, Curator of the Tasmanian Museum, to whom I am indebted for a large collection of spiders.

Epeira ventriosa, sp. nov.

Femina.—Ceph. th., long, 5·7; wide, 4·5. Abd., long, 12; wide, 11; legs, 1, 2—4, 3 = 22, 20, 13 mm.

Cephalothorax lake-brown, passing into brown on posterior incline and lateral borders, moderately clothed with adpressed, silky, whitish hairs; depressed; length equals metatarsus and tarsus of a leg of fourth pair; pars cephalica sub-aplanate, squarely truncated, ocular-eminence prominent; facial index exceeds lateral by one-fourth, equals one-half breadth of thorax; depth of *clypeus* plainly surpasses diameter of a fore-centre eye; pars thoracica ovate; indentation trisected; caput and radial striæ faint; contour of profile represents a moderate, even arch.

Fore-centre *eyes* of about equal size, form a quadrilateral figure widest in front; posterior row slightly recurved, median eyes rather further from fore-pair than they are from each other, an interval visibly surpassing their diameter; their space and a half from laterals; curvature of anterior row perceptibly stronger than hind row; median eyes separated by an eye's breadth and a half, divided from side-eyes by their space and a quarter; laterals one-third smaller than centrals, posited obliquely on a forward projecting tubercular elevation, less than their radius from each other.

Legs and cephalothorax concolorous, annulations broad, brown, not clearly defined; hairs fine, somewhat sparse; spines yellowish, base dark; fairly numerous, irregular; tibial spines equal to its own diameter in length; legs moderately stout, tibial joints cylindrical.

Palpi fuscous, annuli deeper tone; length equal to metatarsus and tarsus of first leg; spines numerous on radial and digital joints; palpal claw short, well curved, 9 teeth, 3 basal rapidly decreasing in size.

Falces deep, raw-sienna; conical, vertical, strongly gibbous at base in front; fore-third divergent, as stout as the femur of a third leg, length equal to anterior row of eyes; 4 teeth on outer row; inner 3.

Maxillæ nearly as broad as long, extremity much dilated, roundly pointed, inclined over *labium,* which is wider than long, sub-triangular; organs olive-brown, pale margins.

Sturnum mahogany-brown; hairs light; cordate; eminences opposite coxal joints.

Abdomen broad-oviform, base pointed; profile-contour ovate; humeral tubercles obtuse-conical; rather sparsely clothed with short, black bristle-like hairs, and soft white, latter following the lighter tints; pattern somewhat obscure; ground colour creamy-brown, mottled, ill-defined patches of a pale olive-brown, few orange-red stains, most pronounced about region of centre figure and tubercles; basal half displays an olive-brown cruciate figure, composed of two longitudinally placed, spindle-shaped spots, and two much smaller lateral spots in line with tubercles; lateral margins show a series of chocolate-brown rib-like streaks, convexities directed backwards; basal end displays a series of fine horizontal streaks, limited by first rib-like line; ventral surface chocolate-brown; shield pale burnt-sienna, large, brown, trapezoidal mark in centre; spinners short; *corpus vulvæ* lake-brown; sub-reniform, of moderate size; sides abrubt, project outwards; face bordered by two narrow costæ, inner black, encloses a heart-shaped area containing two foveæ, divided by a longitudinal groove; apex of area limited by the rima genitalis; springing from anterior border of corpus is a long, tapering, flat, transversely rugose, hairy, yellowish scapus, curving backwards and upwards.

Single specimen. A.M.

Epeira notacephala, sp. nov.

Femina.—Ceph. th., long, 4; broad, 3; facial index, 1·5. Abd., long, 5; broad, 4. Legs, 1, 2, 4, 3 = 12·5, 11·5, 11, 7 mm.

Cephalothorax light brownish-orange, reddish dots, two fuscous spots transversely posited in centre of caput; thoracic part displays two rows 6—2 of similar tinted spots; hind and fore-centre pair enclose a V-shaped figure within fovea. This figure is connected by short bars with next pair of spots in anterior row; marginal band brown, projects a triangular mark on basal half, fades away forwards; fairly-well clothed with rather coarse, whitish, adpressed hairs; length equal to metatarsus and tarsus of a leg of first pair; pars cephalica sub-aplanate, sides abrupt, somewhat retreating; lateral index equals space between a fore-lateral eye and the central furthest from it; depth of *clypeus* equals diameter of a fore-centre eye; pars thoracica oval, convex, fovea sub-circular, shallow; normal grooves faint; profile-contour represents a somewhat prominent arch, cephalic and thoracic incline of about equal grade.

Eyes of fair size, placed on fuscous rings; posterior row perceptibly recurved; median pair visibly more than an eye's breadth apart, their space and one-third from laterals of same row; anterior row more distinctly recurved; centrals one-third larger than hind pair, perceptibly closer to these eyes than they are to each other, an interval surpassing their diameter by one-fourth; divided from side eyes by rather less than two-thirds their space; laterals scarcely one-third smaller than posterior centrals on fuscous rings, oblique, about two-thirds their radius from each other; fore-eye posited on a yellowish projecting tubercle.

Legs pale yellowish stone-colour, fuscous patches and spots on inferior side of femoral and coxal joints, indications of annuli on metatarsi; tarsi shade off rapidly into reddish-fuscous; hairs pale-yellow; spines yellowish, dark base; fine; tibial shorter than transverse diameter of article, numerous; tibiæ of I. and II. have on inferior side a double row of 5, 5; metatarsi 4, 3; legs moderately strong; II. and IV. of about equal length; patellæ and tibiæ compressed, grooves slight; superior tarsal claws—1st pair, 9 comb teeth; inferior claw 2 points.

Palpi colour and armature of legs; length, 4·6 mm.; palpal claw well curved, 10 comb teeth, 2 basal small.

Falces fulvus, glossy, apices brownish; conical, base in front gibbous, vertical, slightly exceed pars digitalis of palpus in length, as stout as the femur of a first leg; double row of black teeth, outer 4, inner 3.

Maxillæ greenish-yellow, centre clouded with light-brown, rather longer than broad, enlarged forwards, obtusely pointed, inclined towards each other.

Labium pale greenish-yellow, base fuscous, wider than long, triangular.

Sturnum light-brown, passing into dark chestnut-brown on margins, spotted; cordate, eminences opposite coxal joints.

Abdomen sub-triangular, base truncated, depressed, humeral tubercles well developed, conical apices brownish, semi-pellucid, project upwards and somewhat backwards; posterior tubercle stout, conical, prominent wrinkle or tubercle beneath; lateral borders rugose; hairs somewhat sparse, appressed, whitish, few pale yellow, dark based, short bristles project from fuscous spots; integument pale brownish stone-colour; folium tapers from fore-tubercles to posterior tubercle, defined by a light fuscous, sinuating line; median streak similar shade; three pair of blue-black impressed spots, two anterior pairs largest, form a trapezoid narrowest in front; light fuscous, nearly vertical, bands on lateral margins. *Corpus vulvæ* fulvus, somewhat triangular, convex elevation, wrinkles transverse, well-defined; broad and concave in front, margins tumid; projecting from within the dark concavity is a yellowish, rather wide septum, as broad at truncated apex as long.

Several examples. A. M.

Epeira singulara, sp. nov. Plate. Fig. 2.

Femina.—Ceph. th., long, 4; broad, 3·4; facial index, 2. Abd., long, 6·7; broad, 6. Legs, 1, 2, 4, 3 = 13, 12, 11, 8 mm.

Cephalothorax bright brownish-lake, clouded about caput and lateral margins with blackish-lake; hairs somewhat sparse, silky white and dark, former predominate on thoracic part; pars cephalica flatly-convex, dips abruptly into depression on posterior incline of thorax; truncation perceptibly rounded, ocular elevation fairly developed, lateral index equals space from a hind-lateral eye to central of same row furthest from it; depth of *clypeus* scarcely equal to diameter of a fore-centre eye; pars thoracica broad-oval, convex, hind-slope occupied by an orange-brown, semi-oval, flatly-convex depression, fovea at apex, triangular, slight; normal grooves not well-defined; profile-contour rises from thoracic junction at a moderate angle, caput curve slopes at an angle of 35deg. to hind-row of eyes.

Posterior and anterior row of *eyes* moderately recurved; hind-median pair separated from each other by an interval equal to their diameter and one-half, and from laterals by their space and three-fourths; fore-centre eyes plainly more than their breadth from one another, rather less than an eye's diameter from posterior centrals, which they equal in size; distance separating them from side eyes visibly surpasses their space; laterals about one-half size of centrals, posited obliquely on moderate tubercular elevations, nearly contiguous.

Legs, femora, especially of I. and II., bright brownish-lake, other joints fulvus, green tinge; annuli fuscous, indications on thighs of III. and IV.; two wide annulations on patellery joints; three on tibial and metatarsal; fore-end of tarsi fuscous; moderately haired; spines brownish, somewhat sparse; tibial spines scarcely equal, transverse diameter of article; patellæ and tibiæ compressed, show two longitudinal grooves; former articles two-thirds length of latter, of equal length on third pair; superior tarsal claws—1st pair, stout, well curved, 8 teeth, 5 strong combs, 3 basal close small; inferior claw long, sharply bent, 2 small points.

Palpi fulvus, green tinge, annuli of pars humeralis and two fore-thirds of digital joint chestnut-brown; hairs whitish; spine armature moderate; palpal claw less curved than tarsal; nine teeth increasing in length and strength.

Falces reddish-chestnut, strongly gibbous at base in front, conical, vertical, half as broad as long; length equal to space occupied by front row of eyes; outer row of teeth, 4; inner, 3.

Maxillæ, length and breadth at extremity about equal, roundly pointed, inclined over *labium*, which is perceptibly wider than long, roundly and somewhat sharply pointed; organs, dark fuscous, margins, greenish-yellow.

Sturnum, lake-black; hairs, white; cordate, centre prominent, eminences opposite coxæ moderate.

Abdomen angular-oviform, projects over base of cephalothorax, depressedly convex above; contour of profile represents a somewhat even curve across dorsum, dips abruptly to spinners from first row of tubercles, depth of dip equal to about one-half length of abdomen; humeral tubercles obtuse-conical, project upwards and outwards; posterior tubercles, 5; first row slightly developed; tubercle of second row most prominent; clothed with short copper-coloured and white hairs; integument has a soft velvety appearance, brownish-fawn colour, speckled with light-brown, largest and scarcest spots deepest hue; folium tapers from humeral tubercles to spinners; margins sinuate, fuscous; flesh colour of tubercles encroaches into the normal fawn-colour; in line with eminences is a centrally-broken fuscous, oblong, transverse mark, connected by a short band with a greenish, ill-defined bar, surpassing the former in length; these marks occur between first and second pair of impressed spots; base of folium angular, defined by dark shading; at constriction of folium on posterior side of second pair of spots is a broken cross-bar; second occurs below third pair of impressed spots; posterior two-thirds of compressed portion of folium obliterated by a remarkable, large, sinuated, brass-coloured patch, metallic reflections, which curves round, suffusing almost all the right side of abdomen; ventral surface dull brown, lake tinge, fuscous clouding; shield fuscous. *Corpus vulvæ*, deep orange, costæ passing into red chestnut, scapus similar tints; stylus lemon-yellow; corpus trapezoidal nearly as wide at base as long, longitudinally depressed, laterally bounded by deep, projecting costæ, increasing somewhat in width towards, and revolute above the rima genitalis; scapus vulva curves over base of corpus, three-fourths its length, elongate-oval, transversely wrinkled, lateral border wide, tapers at fore-end, incurvate; apex of scapus projects rather beyond base of stylus; latter strongly segmented, base stout, second half tapers rapidly, about three-fourths length of scapus.

Only a single example of this handsome species was contained in Mr. Morton's collection; probably the remarkable irregular metallic markings on the abdomen are unique.

Var. a.—Colouration of *cepthalothorax* and *legs* resemble type-form. *Abdomen* grayish-fawn colour, markings deeper tone; pattern does not differ essentially from type-form.

Two specimens. A.M.

Epeira viridula, sp. nov.

Femina.—Ceph. th., long., 2·5; broad, 1·8; facial index, 1. Abd., long., 4; broad 3·5. Legs, 1, 2, 4, 3. = 7·5, 6·5, 6, 4 mm.

Cephalothorax light brown, fuscous clouding; fairly clothed with whitish hairs; clathrate; pars cephalica moderately convex, roundly truncated, ocular elevation prominent; *clypeus* in height visibly less than diameter of a fore centre eye; pars thoracica broad-ovate, convex; posterior incline depressed; fovea sub-oval, shallow, radial striæ well defined, caput grooves moderately; profile line rises from thoracic junction at a tolerable angle to limit of caput, latter horizontal, perceptibly arched, eye eminence projects forwards.

Anterior and posterior row of eyes moderately and somewhat equally recurved; hind median eyes largest of eight, posited obliquely on the more prominent part of eminence, divided from each other by an interval equaling an eye's diameter and two-thirds, and from laterals of same row by scarcely their space and a quarter; fore-centrals less than one-third smaller than hind-pair, visibly more than their diameter from them, removed from each other by a space equal to an eye's breadth and one-quarter, separated from side eyes by rather more than their space; laterals about half size of fore centrals, seated obliquely on a common, strongish tubercle, their radius apart.

Legs fulvus, faint green tinge, fuscous patches on femoral joints, resolved somewhat into distal rings, on III. and IV.; patellæ clouded, tibiæ and metatarsi two annuli; hairs white, somewhat sparse; spines light, scarce; legs strong, patellary and tibial joints compressed, two well-defined grooves; superior tarsal claws—1st pair, 9 comb teeth; inferior claw 2 points.

Palpi colour and armature of legs; palpal claw 10 teeth.

Falces light-fulvus, clouded, conical, vertical, basal half prominent in front; length rather shorter than radial and digital joints of palpus, about as stout as the femur of first leg.

Maxillæ, length somewhat surpasses breadth, enlarged forwards, roundly pointed, inclined over *labium*, latter nearly as long as wide, well pointed, margin tumid; organs chocolate brown, fore-end pale olive brown.

Sturnum blue-black; cordate, eminences opposite coxal joints well-developed.

Abdomen oviform, depressed, humeral tubercles obtuse-conical, directed somewhat outwards and backwards; posterior tubercles well-developed, centre tubercle of first row much the largest and stoutest; tubercle of second line as strong as central of first; third short and fattened; pale brownish-fawn colour, suffused in more or less transverse patches, with dull rifle-green, few spots of same hue; margin of folium acutely sinuate, commences at base of humeral prominences, curves over, tapers to posterior row, obliterated on dip of abdomen; inner border olive-brown, outer creamy-brown; short angular mark of same colour on basal end; ill-defined, somewhat lanceolate, greenish figure in centre of dorsum; lighter shade predominates on ventral surface; shield olive-green, oval. *Vulva* pale yellowish-brown; represents a low, transverse, oval elevation, prolonged into a broad, tapering, flatly convex, close lying scapus, fore-end slightly segmented.

Single example. A. M.

ÆREA, gen. nov.

Cephalothorax rather longer than broad, sub-parallel, lateral constriction slight; cephalic part large, elevated, rather abruptly inclined on all sides from posterior central eyes; anterior angles prolonged into strong, abscinded, sub-conical prominences, depressed above, directed outwards and forwards beyond the frontal line; *clypeus* retreating, centrally prolonged, pointed, depth equal to the space occupied by the fore-centre eyes; thoracic part depressedly convex; at junction with caput on same plane as anterior median eyes, indentation, radial and caput striæ shallow and irregular; contour of profile represents a rather even line rising from thoracic junction, at an angle of 30deg., to posterior central eyes, incline across ocular area somewhat more abrupt.

Eyes tolerably small, in three rows—4, 2, 2; or two procurved rows, posterior line being very strongly curved; fore-centrals form a trapezoid narrowest in front, rather longer than broad behind; laterals posited on truncated apex of lateral projections.

Legs of moderate and somewhat equal length, 1—2, 4, 3; first and second pairs stoutest, of about equal strength; patellary, tibial and metatarsal joints of two first pairs sub-aplanate; patella rather shorter than tibia, metatarsus and tarsus of about the same length; together nearly equal the two former articles in length; tibial and metatarsal joints armed their entire length, on both edges, with long, curved spines, intermediate spaces occupied by 3 or 4 smaller spines of similar form; tarsi furnished with an inner and outer row of close spines, not differing from metatarsal, except that they are shorter and of somewhat even size; tibiæ and metatarsi of third and fourth pairs have a few straight spines; superior tarsal claws of first pair, short, well-curved, 8 comb-teeth; inferior claw sharply bent; axillary claws.

Palpi moderately strong, armed with spines; palpal claw long, slender, 7 teeth, free end short.

Falces of tolerable strength and length, inwardly inclined.

Maxillæ short, length perceptibly surpasses the breadth, fore-end enlarged, roundly pointed, directed towards the *labium*, which is semi-circular, everted, breadth exceeding the length. *Sturnum* sub-oval.

Abdomen sub-rhomboid, base truncated, posterior extremity enlarged, somewhat depressed above

Ærea alticephala, sp. nov. Plate Fig. 3.

Femina.—Ceph. th., long, 3; broad, 2·5; facial index, 2·4. Abd., long, 5·5; broad, 5·5. Legs, 1—2, 4, 3 = 7·5, 6·5, 4. mm.

Cephalothorax lake-black about ocular area, fore-sides of thorax, and lateral margins; dark shade passes between hind-median eyes tapering to limit of caput, enlarged at fovea; posterior incline of cephalic and thoracic parts fulvus, passing into a brownish lake; hairs whitish, appressed, somewhat in lines; luconose; sub-parallel, rounded posteriorly, lateral constriction slight; pars cephalica elevated, slopes on all sides rather abruptly from hind central eyes; grooved depression between latter; fore-angles developed into very stout, sub-conical projections, flatly convex above, directed outwards and forwards beyond frontal line; *clypeus* retreating, pointed, height equal to space of anterior median eyes; pars thoracica depressedly convex, on same plane as fore-centre eyes at its junction with caput; fovea shallow, ill-defined; caput and radial striæ slight, irregular; profile-contour rises from thoracic junction with a somewhat even line to posterior median eyes, at an angle of 30deg, slopes rather more abruptly to anterior centre eyes.

Eyes rather small; anterior row procurved; line through centrals intersects lateral pairs; median eyes posited somewhat obliquely on small, crimson-lake, discoid tubercles, separated from each other by an interval perceptibly exceeding an eye's breadth, and from laterals of same row by nearly twice their space; posterior row straight; forms a very strongly procurved line, with eyes of second row; eyes one-fourth larger than anterior pair, seated obliquely on well-developed, crimson-lake, discoid elevations, about one-fourth further from fore-centrals than they are from each other, an interval surpassing space of anterior pair by scarcely one-third; interval between tubercles fully equal to one-half the distance dividing them from fore-pair of tubercular eminences, separated from hind-laterals by their space and a half; side-eyes placed obliquely on abscinded apices of lateral projections, anterior eye more than twice size of posterior, latter about equal to a fore-central, divided from eye next to it by rather more than one-fourth its own diameter.

First and second pairs of *legs* lake-brown, suffused with chocolate-black, somewhat obscure annuli on tibiæ; hind pairs fulvus; coxal joints, two distal thirds—more or less—of femora and patellæ suffused with dark chocolate-brown; wide basal annulations on tibial, metatarsal and tarsal joints of same shade; legs, 1st pair rather stout, thighs compressed; patella and tibia sub-aplanate, former article grooved, less than one-fourth shorter than tibial joint, latter sub-linear; metatarsus and tarsus of nearly equal length, together scarcely surpassed by the patellary and tibial joints; penultimate article aplanate, base incrassated; hairs whitish and yellowish, most numerous on tibiæ of I. and II.; tibial and metatarsal joints of I. and II. armed their entire length on both edges with long, flattish, brown, curved spines, directed forwards and outwards; metatarsal longest; tibiæ have about 6 on each side; metatarsi 7 on inner, 4 on outer edge; space between long spines occupied by from 3 to 4 much shorter spines of similar form and colour; lateral sides of tarsi armed the whole length with close spines similar but shorter than metatarsal; tibiæ of III. have about 3 spines beneath, 1 above; metatarsi 3 or 4 on inferior side; tibiæ of IV.; IV. pair 1 on superior, 3 or 4 on inferior side; metatarsi 4 or 5; superior tarsal claws—1st pair, short, well curved, 8 comb teeth; inferior claw sharply bent, points ?; axillary claws.

Palpi, humeral and cubital joints fulvus, former article clouded, radial and digital lake-brown, clouded with black brown, both articles fairly furnished with hairs; cubital joint 1 spine; radial 2; digital 7; humeral rather shorter than two following articles together, two latter scarcely equal digital joint in length; palpal claw long, slender, first half straight, second moderately curved; 7 teeth, free end short.

Falces glossy, deep chocolate brown, apices lake tinge; bristle-like hairs at extremity, conical, inclined inwards, scarcely as long as radial and digital joints of palpus, rather stouter than the pars femoralis of a first leg; double row of 5 short teeth.

Maxillæ light reddish brown, pale greenish yellow apices; short, breadth nearly equals length, dilated forwards, roundly pointed, directed towards each other.

Labium chocolate brown, apex pale greenish hue; semicircular, perceptibly wider than long, everted.

Sturnum, dark fuscous; few coarse hairs, sub-oval.

Abdomen sub-rhomboid, base truncated, posterior fourth tumid, convoluted, dotted with small pits, sides dilated; dorsum rises, almost in line with humeral angles, into an obtuse-conical elevation; lateral margins longitudinally wrinkled; abdomen prolonged nearly one-third its length beyond spinners, which are short; darker parts, more especially, marked with rather large, circular or oval lacunose depressions, surrounded by numerous, very fine, sinuating wrinkles; hairs white, short, sparse; ground colour marbled with purple-black and brown; large, deep, creamy-coloured, cruciate figure occupies dorsal area, fore-part nearly as wide as long, displays five light brown impressed spots, three form a procurved line near basal margin, two occur at foot of conical elevation, latter pair and centre spot of anterior line connected by a slight bluish cross; base of cruciate figure short, compressed, terminates at the creamy-coloured posterior third, this part throws off into the dark integument marks of irregular shape, connected with the somewhat sinuating, transverse bar, which curves round humeral angles passing into the creamy coloured ventral surface; vulva and spinners enclosed within an olive-black patch; triangle of three spots in centre, apex directed backwards. *Corpus vulvæ*, dull lake-brown; sub-reniform, moderately depressed area, bounded by an involute costa, inferior margin low and somewhat rugose, much enlarged at curvature, curved extremities divided by a pointed septum, whose breadth scarcely equals the greater width of costa; above the rima-genitalis are two short, black, clavate processes, directed towards apex of septum.

Single specimen. A.M.

COLLINA, gen nov.

Cephalothorax rather longer than broad, sharply constricted on lateral margins; cephalic part roundly truncated, ocular elevation low; fore-half depressedly convex, sides somewhat abrupt, depth exceeds breadth of dorsal surface; fovea and normal grooves well-defined; contour of profile strongly arched, highest part at the occiput; fore-third of caput inclined at an angle of about 45deg.

Eyes of moderate size, sub-equal, posterior and anterior rows slightly recurved, fore-centre eyes form a trapezoid widest in front; laterals separated from each other by an interval scarcely equal to their own radius.

Legs rather slender, moderately long—1, 2, 4, 3; first and second, third and fourth of about equal strength; patellary and tibial joints cylindrical; armature sparse, hairs fine, outstanding; spines slender, bristle-like; superior tarsal claws moderately curved; axillary claws.

Palpi, cubital, radial and digital joints, furnished with long, slender spines; numerous on the penultimate and terminal joints.

Falces conical, inclined forwards, stout.

Maxillæ enlarged towards extremity, roundly pointed, inclined towards *labium* which is rather wider than long, roundly pointed.

Sturnum cordate, eminences opposite coxæ well-developed.

Abdomen oviform, large.

Collina glabicira sp. nov. Plate fig. 4.

Femina.—Ceph. th., long, 4; broad, 3. Abd., long, 7; broad, 5·8. Legs, 1, 2, 4, 3 = 15·5; 12·5; 11·5, 9 mm.

Cephalothorax, chrome-yellow, suffused with a light-brown on cephalic part; freckled with brown; lateral border deeper tone; hairs pale, very sparse; length equals patella and tibia of 4th leg; pars cephalica large, first half depressedly convex, sides somewhat abrupt, roundly truncated, eye eminence low; lateral index equals two-thirds of facial; *Clypeus* retreating, surpasses in depth diamater of a fore-median eye; pars thoracica oval, convex, fovea sub-oval, caput and radial striæ tolerably strong; profile-contour strongly arched, prominent at occiput, dips across fore-third at an angle of 45deg.

Eyes of tolerable and about equal size, on blackish-lake rings; posterior row slightly recurved; centre-eyes divided by three-fourths their diameter, rather more than their space from laterals; anterior row more distinctly recurved, median pair less than their diameter and a half from each other, perceptibly more than an eye's breadth from hind-centrals, removed scarcely three-fourths their space from side eyes; laterals placed obliquely on separate lake-brown tubercular eminences, somewhat less than their radius apart, tubercles small, anterior strongest.

Legs somewhat duller hue than cephalothorax, tibial and metatarsal joints greenish shade; hairs fine, black; spines slender, black; 2 or 3 on femora; patellæ 1; about 6 on tibiæ of I. and II., less on same article of two hind-pairs; metatarsal joints apparently devoid of spines, except metatarsi of III., which have 1 spine; legs somewhat slight, patellery and tibial joints cylindrical.

Palpi and legs concolorous; bristle-like spines rather numerous on pars radialis and digitalis; humeral joint equal in length to cubital and radial together; two latter articles as long as digital joint.

Falces chrome-yellow; hairs black, sparse; conical, base gibbous, inclined forwards; small, plano-convex, conical lobes on outer side.

Maxillæ pale fulvus, base lightly suffused with olive brown, nearly as wide as long, dilated forwards, roundly pointed, directed towards each other.

Labium yellowish, fuscous shading; rather wider than long, roundly pointed, one-half length of maxillæ.

Sturnum fulvus, marbled with brown; heart-shaped, eminences opposite coxal joints.

Abdomen broad oviform, projects over base of cephalothorax, convex above; ground colour dull lake-brown, suffused with flecks; dorsum flecks dark creamy-colour, lobate, more or less confluent; medial streak, normal colour, terminates at posterior incline, displays four—probably in some examples five—arcuate lines of similar colour; flecks on lateral margins inconspicuous, approximate to ground colour; ventral shield olive brown; branchial opercula chrome-yellow. *Vulva* orange brown; transverse, oval area, occupied by two deep, circular foveæ, intersected by a dark bordered, broad septum, their equal in breadth, laterally prolonged above the rima genitalis, extremities acute, revolute.

Single example. A.M.

FAM. CELAENIDEN.

Gen. CELAENIA, Thor.

Celaenia voraginosa, sp. nov. Plate Fig. 5.

Femina.—Ceph. th., long, 5·2, broad, 6. Abd., long., 10; broad, 14; deep, 11. Legs, 1—2, 4, 3 = 21·2, 12, 10 mm.

Cephalothorax deep fulvus, olive tinge, passing into coffee-brown on lateral margins, furnished with numerous papillæ —mostly in rows, projecting, short, stout, black bristles; somewhat reniform, narrowly constricted at caput, pars cephalica, rather depressed, sides abrupt, mamiform eminences well-developed; prolonged somewhat upwards into a stout sub-conical projection, nearly as long as wide at base, occupying greater part of frontal space; *clypeus* retreating, depth perceptibly exceeds interval between a fore-centre eye and the lateral next to it; pars thoracica—viewed laterally, obtuse-conoid; series of six indentations occur at edge of posterior inclination, centre pair divided by the bisected fovea; radial striæ somewhat deep and short; caput grooves faint forwards, form strong, angular depressions at limit; profile-line rises at an angle of 30deg. from thoracic junction, dips forwards at a rather stronger inclination to mamiform elevation—which represents an obtuse-conoid projection, bends slightly upwards to posterior row of eyes.

Eyes tolerably small; posterior row recurved, line through centrals strikes fore-edge of anterior laterals, front row more strongly recurved; fore-central eyes posited on prominence, form a nearly quadrilateral figure, enclosing conical apex, front line rather shorter than hind, visibly surpasses sides; posterior pair one-third smaller than fore-centrals, placed on slight discoid elevations; anterior pair little more distant from side eyes than are the hind-centrals, a space about equal to the interval between one another; laterals scarcely equal to hind centrals in size, seated obliquely on a strong prominence nearly contiguous.

Legs creamy-yellow, second half—rather less—of femoral joints coffee-brown, stains on first half; patellæ and annulations normal brown; tibiæ have three wide rings; metatarsi three less defined annuli; tarsi suffused; annulations on tibial and metatarsal joints of two posterior pairs somewhat obliterated; I. and II., III. and IV. of about equal strength;

femora of two first pairs much the stoutest; tibial joints cylindrical, slender, about one-third longer than patellæ; metatarsi nearly twice length of tarsi, together one-third shorter than tibæ; hair short, somewhat sparse; femoral joints of I., II. and III. armed on inferior side with two irregular rows of sub-conical tubercles of various sizes, projecting short spines, tarsal claws of normal form; outer claw much the longest and strongest; inner sharply curved, three close teeth at base; inferior claw closely inflected, perceptibly stronger than inner; two pairs of axillary claws.

Palpi, pars humeralis creamy-yellow, brown rings, following joints fulvus, suffused with brown; armature short, black hairs; moderately long, stout; radial joint rather the longest and strongest, enlarged forwards; cubital joint much the shortest; pars humeralis and digitalis of about even length; palpal claw stout, sharply bent, 3 close teeth.

Maxillæ light coffee-brown; apices pale, greenish; moderately enlarged forwards, pointed, directed towards each other.

Labium base brown, fore-half pale; oval, rather wider than long.

Sturnum chocolate-brown, well-defined, large, yellowish lanceolate figure in centre, point directed towards lip, haft tapers to posterior end; cordate, tapers from the somewhat prominent eminences opposite coxal joints of third pair.

Abdomen large, nearly one-third wider between humeral tubercles than long; base rather broader than cephalothorax, concave, angles prominent, rounded; viewed laterally conoid, apex abscinded; summit occupied by large convoluted, somewhat semi-globose humps, sloping abruptly to the short, conical humeral tubercles, divided by a level space about one-half their own diameter; each hump indented by seven deep pits, three of which occur on each margin of intervening space; hind lobes of humps project over the abrupt posterior end, which is semi-oval; the outer pair display at their extremity brownish, nipple-like tubercles; posterior face of abdomen shows several well-marked foveæ, two largest form a trapezoid, widest below, with the hind-pair of the above-mentioned six pits; semi-circle of five impressed spots on posterior side of humeral tubercles; between hind-pair of foveæ and spinners is a large, somewhat oval space enclosed by small pits, area occupied by two centrally interrupted, transverse indentations; anterior slope slightly pitted; fore-part of abdomen creamy-colour, graduating into patches of pale brownish tints; on margin of basal concavity is a black, heart-shaped figure, on either side of it two streaks curve off towards fore-tubercles, upper streak brown, lower bluish; summit and posterior side light greyish fawn colour; humps and fore-sides appear to be tattooed with bluish lines, pattern on fore-slope without any determinate limits, fades away into ground colour; anterior border of humps and posterior border of fore-patches blackish, somewhat sinuating, curve round the creamy-brown humeral tubercles; resolved behind into conspicuous, indigo-coloured, lunulate marks curving upwards round apex of the semi-oval area; latter and impressed spots on posterior region reddish. *Vulva* represents a narrow, transverse, brownish depression, projecting—over the rima genitalis, a moderately deep, cup-shaped, yellowish process.

Single example. A.M.

Celaenia tumidosa, sp. nov.

Femina.—Ceph. th., long, 6; wide, 6·8. Abd. long, 10·2; wide, 15; deep, 10. Legs, 1—2, 4, 3 = 23, 14, 12, mm.

Cephalothorax light mahogany-brown, passing into pale yellow-brown on margins, olive tinge; somewhat suffused and speckled with olive-brown; numerous papillæ projecting short, black hairs, chiefly in rows; cephalic part somewhat aplanate, sides abrupt; produced forwards and moderately upwards into a strong sub-conical projection; mamiform eminences well-developed; *clypeus* retreating, height visibly surpasses interval between a fore-median eye and the lateral next to it; thoracic region—viewed laterally, conoid, margin of hind-slope displays six rather deep indentations, bisected fovea intersects central pair; radial striæ well-defined, short; caput grooves represent deep angular indentations at junction with thorax, shallow forwards; contour of profile rises from thoracic junction at an angle of 30deg., inclined at about the same angle to base of the obtuse-conical mamiform prominences, bends slightly upwards to hind row of eyes.

Eyes rather small; fore-centrals about one-third larger and fore-laterals one-third smaller than hind-median pair; posterior lateral eyes visibly smaller than anterior pair; posterior row recurved, line through centrals intersects side-eyes; anterior row recurved, curvature stronger than posterior; fore-centrals seated on prominence, enclose conical apex; hind-pair rather more distant from each other than are the fore-pair, interval between latter pair visibly surpasses the space separating them from posterior centrals, which are posited on small discoid tubercles; fore and hind-centre eyes divided from laterals by an interval perceptibly exceeding space between fore-centrals; side eyes seated obliquely on tolerably strong elevations; three-fourths diameter of a posterior eye apart.

Legs green-tinged straw-colour, markings coffee-brown; second half of femoral joints dark; first half of anterior pair splashed; patellæ uniform brown, more or less broken and confluent annuli on tibiæ; fore-end of metatarsi and tarsi suffused; I. and II., III. and IV. of about equal strength; thighs of first and second pairs much the strongest; tibiæ cylindrical, slender, one-third longer than patellary joints; metatarsi twice as long as tarsi, together shorter than tibial joints by one-third; hairs, fine, short; femoral joints of first, second, and third pairs armed beneath with two irregular rows of sub-conical tubercles, of different sizes; projecting short black spines; outer superior tarsal claw much the stoutest and longest; inner claw sharply curved; three close teeth; inferior claw closely inflected, somewhat exceeds inner both in length and strength; axillary claws.

Palpi greenish-brown; armature, fine, black hairs; stout, moderately long; radial joint incrassated forwards, surpasses other articles in length and strength; pars cubitalis, short; penultimate and digital joints of about same length; palpal claw short, sharply bent; three close teeth.

Falces greenish-brown, suffused with a deeper shade; somewhat hairy; taper moderately, directed inwards, fully as long as pars radialis of palpus; about as stout as basal end; fang, short.

Maxillæ, light greenish-brown, short; second half dilated, roundly pointed, directed towards each other.

Labium and maxillæ concolorous, perceptibly broader than long, semi-circular.

Sturnum fulvus, border fuscous, haired, oval.

Breadth of *abdomen* between the short, outward projecting humeral tubercles exceeds the length by scarcely one third; profile contour sub-conoid, anterior slope moderate, posterior dip abrupt; base procurved between anterior rounded protuberances; crest occupied by two large semi-globose, convoluted humps, prominent behind, separated by a level area about one half their diameter; impressed spots which occur on humps and on the fore and hind smooth regions do not differ essentially in their arrangement from the similar indentations found on *T. voraginosa*; ground colour of anterior slope creamy-fulvus, black heart-shaped spot above petiole throws off on either side, two olive-black sinuating lines converging towards each other on inner side of fore protuberances, latter display at their base, upper side, a dark impressed spot; humps closely tattooed with bluish-green lines and leaf-like marks; sides of anterior incline figured with similar but more open pattern; posterior side has a light copper-brown hue, suffused with an olive-brown shade, faint bluish streaks, indentations similar tint. *Vulva* (somewhat shrunken) represents a transverse, brownish, oval indentation, margin above the rima genitalis produced into a rather large everted lip, brownish yellow above, whitish beneath.

Single example. A. M.

EXPLANATION OF PLATE.

Fig. 1. *Epeira Mortoni*, sp. nov. Vulva.

Fig, 2. *Epeira singulara*, sp. nov. Vulva.

Fig. 3. *Ærea alticephala*, sp. nov. Female, three times natural size ; a, caput ; b, part of a fore-leg ; c, vulva.

Fig. 4. *Collina globicira*, sp. nov. Female, three times natural size ; a, vulva.

Fig 5. *Celaenia Voraginosa*, sp. nov. Caput.

NOTES ON ACTINOMYCOSIS, AND ITS TRANSMISSIBILITY TO THE HUMAN SUBJECT.

By C. E. Barnard, M.D.

While I cannot but feel that some apology is due to the Royal Society for introducing a subject that might perhaps be regarded as purely medical, this feeling is removed by the consideration of its important bearing upon the public health, and may be held to justify me in bringing it before the Society. I refer to the question of the transmissibility of some bovine diseases to human beings by the consumption of the meat of diseased animals.

The primary object of my paper is to show that there is prevalent amongst the cattle in Tasmania, as well as in the adjacent colonies, from which we obtain a large proportion of our meat supply, a disease which resembles tuberculosis in some respects, but differs from it in the specific micro-organism that is the cause of the disease, and yet, like tuberculosis, is transmissible to the human subject, and is almost as distressing in its consequences.

Six years ago Dr. Perkins read an interesting paper before this Society on "Cancer in Cattle," and ably pointed out the probable danger of the use as food of animals affected with cancerous or osteo-sarcomatous swellings; and he urged that precautions should be taken to avoid the probable transmission of cancer to man by eating the flesh of animals so diseased.

As the tumours in the cases described resembled in external appearance those swellings that are undoubtedly due to a scrofulous taint or tuberculosis, Dr. Perkins considered that they also might be classed as such; and judging by his paper, he apparently was unaware of the true nature of the disease in question. He well described the appearance of the swellings, and, by microscopical and other specimens, he showed how the bone was affected, and how the tumours grew and formed secondary deposits in the system; but there is no mention of the specific micro-organism which is now found to be the cause of the growth.

At the time of his writing the paper there was no accurate knowledge available that would give any clue to the true cause of the cancer. Dr. Perkins himself did not regard it as ordinary cancer, for he says that "though I have examined several specimens, I have not yet come upon cells which in any way resemble those of cancer," and he favours the idea that the tumours are due to tuberculosis.

Previous to Dr. Perkins's paper, Mr. Willows, N.S.W. Government Veterinarian, in conjunction with Mr. Park of Hobart, was empowered by the Hon. the then Premier of Tasmania to report upon the alleged cancer in cattle of this colony. In his report Mr. Willows considered the tumours to be due to a tuberculous taint; and he urged that prophylactic measures be rigidly enforced with a view to stamp out the disease, and he concludes by saying, "I am of opinion that the consumption of meat or milk from scrofulous or tuberculous animals is always dangerous."

In Europe this disease, so far as it was judged by external appearances, had been long recognised, and was described under various designations, such as osteo-sarcoma, cancer, etc., and usually it was attributed to a tuberculous condition of the system affecting the glands.

It is only of comparatively recent years, since 1876, that these tumours have been demonstrated to be due to the presence of a parasitic fungus, called actinomyces or ray-fungus, from its ray-like appearance, and hence the disease is called Actinomycosis.

Soon after the publication of the discovery of the actinomyces or ray-fungus in diseased cattle, the same vegetable parasite was found in man; and it was then seen that the tumours in the bovine species presented great similarity to those found in the human subject, leading to the presumption that it was identically the same disease.

Besides cattle the actinomyces have been found in animals which have suffered from cancerous disease, as the pig, and the dog.

About four years ago Mr. Archibald Park who has carefully studied this subject, called attention to the presence of certain peculiar bodies in these cases of cancer, which he thought differed from true tuberculosis. And as the published accounts in the veterinary literature of the day, of the discovery of actinomyces in a similar disease to this cancer in Europe, agreed with what he observed in the cases in Tasmania, Mr. Park came to the conclusion that the disease in this colony must be the Actinomycosis of Europe.

Previous to his departure to England nine months ago Mr. Park brought me a specimen of one of these osteo-sarcomatous tumours from the lower jaw of a cow. Having made sections we examined them under the microscope, when the distinguishing characteristic club-shaped bodies of the actinomyces or ray-fungus were unmistakably seen, agreeing in all respects with the published accounts of the parasite, thus establishing the fact of the disease in Tasmania being undoubted Actinomycosis.

Having taken with him to England this same specimen, Mr.

Park showed it to the best authorities in London, who confirmed the diagnosis, and were much interested in the discovery.

Sections of the specimens referred to are now on the table for inspection, when members will be enabled to examine by the microscope the peculiar ray-fungus that is associated with the disease in question.

The fungus tufts vary in size from a pin's point to a pin's head, and may be readily seen with the low power of the microscope; but it requires a high power to distinguish the characteristic club-shaped bodies which are arranged in the form of a rosette, or in a radiate manner. When thin sections are cut the larger tufts drop out, leaving round vacant places which give the specimen a reticulated appearance.

Appropriate staining brings out very prominently three different elements which are easily distinguishable under the higher power; first minute granules, or micro-cocci; second, fine threads of mycelium; third, disposed in a radiate manner round the edge of the tufts, larger ovate or club-shaped bodies.

These three elements are not always to be found in the same specimen, and frequently the clubs are not seen, or possibly are not brought out in the staining; but when found they are deemed to be the characteristic element of the darasite. The discovery of this parasitic fungus has been the starting point for many valuable investigations; and it is surprising to find how many obscure diseases there are whose origin may be traced to the presence of this vegetable parasite, and many diseased organs thought to be suffering from tuberculosis have been found to contain the actinomyces, and not the tubercle bacillus.

Our chief interest in the fungus is centred in the fact that identically the same parasite as is found in the lower animals is discovered to be the cause of similar diseases in the human subject. Several well-authenticated cases have been published of undoubted Actinomycosis in human beings having a fatal termination. How these patients became inoculated with this disease it is difficult to say.

It has been shown by experiment that the introduction of the fungus by inoculation into a calf has produced swellings which contained the characteristic clubs of the fungus, thus suggesting that this disease can be transmitted by direct inoculation.

Many similar experiments have been made with a view to prove the transmissibility of this vegetable parasite from animal to animal, and in the majority of cases with a positive result.

There can be no doubt that, in whatever way the actinomyces are taken into the human system, whether by injection, inhalation, or inoculation, there is every liability of their growing and multiplying to the injury of the patient.

The fungus may find entrance by wounds and abrasions of the mucous membrane of the mouth and alimentary system, in a similar manner that other micro-organisms have been proved to enter.

Wherever they find a lodgment they proceed at once to develop, forming mycelial threads and spores; and just as in the case of similar parasites, they set free, in the vicinity of the parent fungus, spores, which give rise to fresh individuals. These spores are carried about by wandering cells, and in this way they give rise to fresh centres of growth. Although it may be well understood how the actinomyces increase and multiply inside the animal system, when once introduced, there is some difficulty in ascertaining the mode of infection from without.

As the most common seats of the disease in cattle are the tongue and jaws, this fact seems to point to lesions in this region as being the mode of entrance of the actinomyces; and where the lungs are alone affected probably the minute fungus has been inhaled. And as it has been observed that the fungus prevails on some pastures to an unusual extent, it is natural to suppose that the animals have acquired the disease through grazing on such sharp-pointed grasses as wound the mucous membrane of the mouth, such as the spear grass, and also briars, gorse, etc.

In whatever way the disease is propagated, there should be no hesitation in arriving at the conclusion that all possible endeavours should be made to prevent the spread of the disease to man, and to lessen the risk of infection by the most obvious methods, such as the destruction of infected animals, and the prohibition of the diseased meat from being used as food. Every animal suffering from the disease is a menace not only to its fellows in the same field, but also to the human beings brought into contact with it.

One may compare this disease to leprosy, which is caused by a microscopic bacillus, and which is highly infectious by contact; and as a practical consequence of this infectivity the leper is kept isolated from others.

Mr. Park, when recently in Queensland, made some inquiries as to the extent to which this cancerous disease prevailed there, and ascertained that cases of human Actinomycosis were frequently met with, more especially on those runs where the cattle were similarly affected. It is believed, upon medical authority, that many of the cases of cancer occurring in Queensland are attributable to the ray-fungus, or in other words are Actinomycosis.

In Queensland, since December of last year, the owners of diseased cattle have been compelled, by regulation of the Public Health Act, to destroy all animals affected with these cancerous diseases; and all animals exposed for sale as food in the market, proved to be diseased, can be seized and destroyed.

On some of the cattle runs it is said that this disease prevails to the extent of about 10 per cent.; and as we obtain some of our meat food from this region, a rigid inspection of all animals arriving by sea is highly necessary.

At Kiama, in N. S. Wales, Mr. Stanley, the Government Veterinarian, at the instance of the Board of Health there, made enquiries into the causes of diseases, tuberculosis and cancer, affecting dairy cattle in that district. In the milking cows he found tuberculosis and Actinomycosis; and tuberculosis in the pigs that were being fed on the milk from those cows which supplied the local butter factory, and which likewise were fed on offal from the slaughteryards.

These facts have been confirmed by Mr. Park, in an examination of portions of the diseased structures taken from these animals given to him by Mr. Stanley. Microscopic slides of these specimens are on the table and can be examined by the microscope, when the actinomyces will be plainly visible.

The presence of actinomyces in these specimens, as well as of the tubercle bacilli, is confirmed by the diagnosis of three medical experts in Sydney, who were called upon to make a microscopic examination of the diseases in question, and who have published their opinions on the subject in the report of the Board of Health of N.S. Wales, dated 9th October, 1890.

The few facts that I have been enabled to bring before the Society this evening show that there is a large field for investigation which has scarcely as yet been entered upon. If the diseases I have been discussing were thoroughly investigated in this colony, and experiments made with a view of testing the extent of the prevalence not only of these, but of other diseases, valuable results would no doubt be shown. And I cannot too strongly urge that this investigation should be made, for, as in the case of tuberculosis and Actinomycosis, other diseases will be found to prevail more extensively than has hitherto been suspected.

A Central Hygienic Institute was recommended by the last Intercolonial Stock Conference, to which all cases of disease amongst animals should be referred from all the colonies. Without some such institution it is not easv to see how information can be obtained as to the extent these diseases prevail in our midst.

A similar institution should be founded in connection with the Health Department of this colony, as modern science now is not content with mere superficial examination, but proceeds with more strict and reliable methods to detect the micro-organisms, which are undoubtedly the active agents in the production of disease.

I cannot conclude these notes better than by quoting the closing words of Professor Robert Koch in an address before the International Medical Congress held in Berlin, August, 1890, in which he had for the first time clearly foreshadowed the result so far of his researches for the purpose of discovering a method of arresting the development of tuberculosis in the animal system, and had expressed a hope that he was on the eve of complete success in obtaining this grand result. He concludes as follows:—"Allow me, therefore, to conclude this address with the expression of a wish that the nations may measure their strength on this field of labour and in war against the smallest, but the most deadly foes of the human race, and that in this struggle for the weal of all mankind one nation may always strive to surpass the other in the successes which it achieves."

WHAT SCIENCE AND COMMERCE MAY GAIN FROM AN ANTARCTIC EXPEDITION.

By A. Morton, F.L.S.

What is to be gained from an Antarctic Expedition is a question so frequently asked that some notice should be taken of it, and an answer framed that, if possible, shall be satisfactory.

Perhaps a reference to what has been done by Arctic Exploration may encourage belief that some benefit would accrue from a properly equipped expedition to the Antarctic region. Observations in the far north have been of incalculable value for the confirmation or correction of scientific theories relating to ocean currents, magnetic deviations, climatology, geographical distribution of plants and animals, and a host of similar subjects; while, as to commerce, it is only necessary to mention the discovery of the White Sea route to Russia, with its consequent trade, the establishment of the Spitzbergen fisheries, and the opening up of new and lucrative whaling grounds in Baffin's Bay and Prince Regent's Inlet, as convincing proofs of the usefulness of many expeditions that promised less in the way of discovery than one to the Antarctic regions. Magnetic researches of the higest value were made during the voyage of Captain Ross to the South Polar regions, and he was able to fix the position of the line of non-deflection of the compass.

Until we know all that can be discovered as to the limit of pack ice, the extent of the Antarctic Continent, the influence of Mount Erebus, the distribution of flora and fauna, and the probabilities of successful whale fishing, there will still be enough to gain, either from a commercial or scientific point of view, to make it worth while to send an expedition to the Antarctic regions. If the *Times* (England), has been correctly reported, it advocates, in preference to an Antarctic Expedition, a fresh attempt to discover traces of Leichhardt in Central Australia. One can scarcely conceive what comparison is possible between the two, though each might be said to be desirable from different points of view, but if they are to be compared, I should be inclined to think that by far the greater advantage, whether for scientific or commercial purposes, lies with the expedition we are considering.

Dr. Neumayer, who for many years has kept the subject of Antarctic Exploration before Germany and the world, com-ments on the importance of scientific observations inside the Polar Circle, and maintains that for the purpose of discovering those general laws which are necessary as guides and standards in the interpretation of phenomena in climatology and physical geography generally, the South Polar regions are much better adapted than the North. The dictum of Captain Cook, that the ice he met in lat. 71deg. 10min. S. extended to the Pole, and his prediction that no man would venture further than he had done, was set aside successfully by Captain Ross, who penetrated 420 miles to the south of the point at which the great navigator turned back.

With the general results of his voyages, accomplished, be it remembered, without the aid of steam, you are all perfectly familiar. And here let me say that while heartily sympathising with the Geographical Society of Australasia in its efforts to assist the proposed expedition under Baron Nordenskiold, and appreciating the private liberality which has been displayed in the matter, I yet think the sum of £10,000 quite inadequate to produce any great results, or to fit out an expedition that would do much more than has already been done.

Let England and Australasia unite in sending an expedition, so equipped and manned, that failure, if not impossible, shall at least be unlikely, and we may confidently look for results that shall satisfy even the most incredulous as to the wisdom of Antarctic Exploration. Some remarks by Dr. Petermann on "Circumpolar Expeditions," read at a meeting of the Royal Geographical Society, of London, are worth quoting for their applicability to the case in hand:—"Although the Geographical and Scientific world," he says, "would be contented were an Expedition sent out for the sake of Science alone, nevertheless the whale fisheries in the Polar regions are also of great importance, as instanced by the one fact that the American whale fisheries in Behring Straits amounted in two years to the value of 8,000,000 dollars. . . . The English, having the best men, vessels, outfit, and resources, are best fitted to send out an expedition. When the French and American Expeditions, under Captain d'Urville and Lieutenant Wilkes, were sent out to the Antarctic Seas, together with Sir James Ross, it was clearly seen that only the English were quite at home in the Polar elements; they fearlessly went on with their important explorations for three consecutive years, whereas the other squadrons were always beaten back in their attempts to penetrate towards the South Pole. Captain Sherard Osborne, R.N., C.B., an eminent authority on the Polar regions, in a paper read before the Royal Geographical Society of England in 1865, speaks as follows:—"An exploration of the Polar area should always be sent under naval auspices and naval discipline. I have no faith in purely private expeditions; on such a service as this I advocate we need all the resources of a naval dockyard, all the special knowledge collected in various departments—whether in the preparation of vessels, food, raiment, sledges, or equipment—to insure the work being well and safely done. The Navy of England cries not for mere war to gratify its desire for honourable employment or fame, there are other achievements it knows well, as glorious as victorious battle. Upon these points, as well as those of scientific results, it would not be too much to ask for a fraction of the vast sum yearly sunk in naval expenditure, for two small screw vessels and 120 officers and men, out of the 50,000 men annually placed at the disposal of the Admiralty."

This practical advice, coming from such an authority in 1865, is worthy of serious consideration at the present moment. In a letter written by Lady Franklin, dated Madrid, April 6, 1865, the following passage occurs:—"For the credit and honour of England, the exploration of the North Pole should not be left to any other country. It is the birthright and just inheritance of those who have gone through fifteen years of toil and risk in Arctic Seas. The glory that yet remains to be gathered should be theirs."

I should like to say in concluding, for the credit and honour of England and Australasia, the exploration of the South Pole should not be left to any other country, but should be taken up by England, who would, I am sure, be ably and willingly assisted by her loyal Australasian subjects.

DESCRIPTION OF A FERN *(BLECHNUM CARTILAGINEUM)*, NEW TO THE TASMANIAN LIST.

By R. M. Johnston, F.L.S.

By the kindness of Mr. Leonard Rodway I have had the opportunity given me for making a critical examination of a new fern discovered recently at George's Bay by Mr. G. K. Hinsby. Both of these gentlemen are well known as industrious collectors of plants, more especially as regards our little known *Fungi*, and we may hope to gain from them at some early day further valuable additions to our knowledge of the Cryptogamic plants of this island.

The new fern submitted to me by this gentleman might at first sight be readily mistaken for some of the abnormal forms of *Lomaria discolor*, where, at times, several of the pinnæ of the fertile fronds are less contracted or enrolled upon each other; but a closer examination showed that the lines of *sori* were arranged differently, being continuous, and situated close and parallel on each side of the costule, with a membranous indusium opening from under the costule outwards, and thus answering exactly to the generic characteristics of *Blechnum*. This genus is very closely allied to *Lomaria*, but in the latter (whose linear sori are placed nearer the margin, and opening on the inner side next to costule), the sori at length covers the whole of the under surface, and these are themselves often closely enwrapped by the marginal borders of pinnæ which sometimes assumes a cord-like appearance by the extreme flexure. The margin of the species of *Blechnum* about to be described are not so characterised, the sori only at length covering the costule and middle of pinnæ; the margins are not reflexed.

Still further examination showed that the species discovered by Mr. Hinsby was in all respects identical with *Blechnum Cartilagineum*, Swartz, a species hitherto only known from the mainland of Australia, where it is found in similar situations, *i.e.*, along creek-sides and borders of scrubs, in southern Queensland and New South Wales, and in several places in Gippsland, Victoria. The addition of a new *genus* as well as a new *species* to our list of Tasmanian Ferns, is of the very greatest interest, and now that we know of its existence locally, I am convinced it will soon be discovered in other localities, where possibly it has been overlooked or confounded with the everywhere abundant *Lomaria discolor*. I have a vague idea (now that I have examined the George's Bay specimen), that I have seen the same fern on the banks of the North Esk, overhanging the river between Launceston and St. Leonard's. The Launceston botanists might easily verify this matter.

The following is a description of the new species thus referred to :—

Genus Blechnum. Linn.

Rhizome short and thick, or slightly elongated, and horizontal or erect; *fronds* pinnate, deeply pinnatifid, or in some species (not Australian) bi-pinnate or even simple; *pinnæ,* or segments, narrow; *sori* in a continuous line on each side of the costule, with a membranous indusium opening from under the costule outwards, the two sori often at length confluent, concealing the costule (mid-rib.)

B. Cartilagineum. Swartz.

Caudex oblique, densely clothed at the crown with blackish febrillose scales; *stipes,* strong, erect, 4-6in. l., scaly and muricated in the lower part; *frond,* ovate-oblong, 1-2ft. l., 6-9in., br· ; *pinnæ,* numerous, erecto-patent, linear, 4-6in. l., $\frac{1}{4}$-$\frac{1}{2}$in. br., narrowed gradually towards the point, the margin finely toothed, dilated and connected at the base, the lower ones not conspicuously smaller than the others; *texture,* coriaceous; *rachis* and both surfaces naked; *veins,* fine; *sori,* in a broad line, *close* to the mid-rib. Hab.—Temperate Australia (New South Wales, Queensland, Gippsland, Victoria: George's Bay, Tasmania.)

TABULAR LIST INDICATING THE LOCAL HABITATS AND THE GENERAL DISTRIBUTION OF ALL THE KNOWN FERNS, CLUB MOSSES, AND PILLWORTS OF TASMANIA.

By R. M. Johnston, F.L.S.

Since my "Field Memoranda for Tasmanian Botanists" was published sixteen years ago (1874), there has been a considerable alteration in the nomenclature of species as adopted in Hooker's Flora of Tasmania, as well as additions to the list of species then known. Now that our zealous Secretary is about to issue a new and comprehensive Descriptive Catalogue of all the Ferns of the island known at the present time, I have thought it desirable to place on record a revised list of the species, together with as complete a list of the localities of the various species as are known to me, with the desire to aid him in making this portion of his valuable work as complete as possible.

Tasmanian Ferns, Club Mosses and Pillworts.

FILIGES.

Tribe i. Ophioglosseæ.

1. Ophioglossum vulgatum. *Linn.* Adder's-tongue.
2. Botrychum lunaria. *Swartz.* Moonwort.
3. ———— ternatum. *Swartz.* Grape Fern. (B. virginianum.)

Tribe ii. Schizaceæ.

4. Schizea fistulosa. *Labill.*
5. ——— bifida. *Swartz.*

Tribe iii. Osmundeæ.

6. Gleichenia circinata. *Swartz.* Parasol Fern.
7. ———— dicarpa. *R. Br.* (G. microphylla.)
8. ———— flabellata. *R. Br.*
9. Todea barbara. *T. Moore.* (T. Africana.)

Tribe iv. Hymenophylleæ.

10. Trichomanes venosum. *R. Br.* Bristle Fern.
11. Hymenophyllum marginatum. *Hook. et Grev.* Filmy Fern.

12. Hymenophyllum rarum. *R. Br.* Filmy Fern
13. ———————— javanicum. *Spreng.* Filmy Fern. (H. flabellatum.) (H. demissum.)
14. ———————— tunbridgense. *Swartz.* Filmy Fern.
15. ———————— *var.* Wilsoni. *Hook.* Filmy Fern.
16. ———————— Malingii. *Metten.* Filmy Fern.

Tribe v. CYATHEÆ.

17. Cyathea medullaris. *S. W.* Black Tree Fern.
18. Alsophila australis. *R. Br.* Prickly Tree Fern.
19. ———— excelsa *var.* Cooperi. *R. Br.*

Tribe vi. POLYPODIEÆ.

20. Dicksonia antarctica. *Labill.* Woolly Tree Fern.
21. Davallia dubia. *R. Br.* Prickly Tree Fern. (Dicksonia.)
22. Lindsayea linearis. *S. W.*
23. ———— trichomanoides. *Dryana.*
24. Adiantum æthiopicum. *Linn.* Maiden Hair.
25. ———— formosum? *R. Br.* Maiden Hair
26. Hypolepis tenuifolia? *Bernh.*
27. Cheilanthes tenuifolia. *S. W.* Parsley Fern.
28. Pteris falcata. *R. Br.* Ear Fern. (Platyloma, Pellæa.)
29. ———— tremula. *R. Br.*
30. ———— aquilina. *Linn.* Bracken.
31. ———— incisa. *Thumb.* Bat's-wing. (Litobrochia.)
32. ———— comans. *Forst.* (P. Endlicheriana.) (Litobrochia.)
33. Lomaria Patersoni. *Spreng.*
34. ———— vulcanica. *Blume.*
35. ———— discolor. *Wild.*
36. ———— lanceolata. *Spreng*
37. ———— alpina. *Spreng.*
38. ———— fluviatilis. *Spreng.*
39. ———— capensis. *Wild.* (L. procera.)
40. Blechnum cartilagineum. *S. W.*
41. Doodia aspera. *R. Br.* Prickly Doodia.
42. ———— *var.* caudata. *R. Br.*
43. Asplenium trichomanes. *Linn.* Maiden hair spleenwort.
44. ———— flabellifolium. Fan-leaved spleenwort.
45. ———— obtusatum. *Forst.*

46. Asplenium bulbiferum. *Forst.*
47. ——— flaccidum. *Forst.*
48. ——— umbrosum. *J. Sm.* (A. Brownii.) (Athyrium)
49. Cystopteris fragilis. *Bernh.* Little bladder Fern.
50. Aspidium aculeatum. *S. W.* Lady Fern. (Polystichum vestitum)
51. ——— capense. *Wild.* (Polysticum coriaceum.)
52. ——— decompositum. *Spreng.* (Nephrodium.)
53. ——— hispidum. *Sw.*
54. Polypodium australe. *Melten.* (Grammitis.)
55. ——— grammitidis. *R. Br.*
56. ——— punctatum. *Thumb.* P. rugosulum.)
57. ——— pustulatum. *Forst.* (P. Billardiera), (Phymatodes.)
58. Grammitis rutæfolia. *R. Br.* Blanket Fern. Gymnogrammæ.
59. ——— leptophylla. *S. W.* Jersey Fern. Gymnogrammæ.

LYCOPODEÆ.

1. Phylloglossum Drummondii. *Kuze.*
2. Lycopodium selago. *Linn.* Fir Club Moss.
3. ——— varium. *R. Br.*
4. ——— clavatum *var.* fastigiatum. *Linn.*
5. ——— Caroliniana. *Linn.*
6. ——— laterale.
7. ——— diffusum. *R. Br.*
8. ——— densum. *Lab.*
9. ——— scariosum. *Forst.*
10. Selaginella Preissiana. *Spreng.*
11. ——— uliginosa. *Spreng.*
12. Tmesipteris tannensis. *Bernb.*

MARSILEÆ.

1. Isoetes Gunnii. *Braun.*
2. ——— humilior. *Müell.*
3. ——— elatior. *Müell.*
4. ——— Stuartii. *Braun.*
5. Azolla feleculoides. *Lam.* (A. rubra.)
6. Pilularia globulifera. *Linn.*

ABBREVIATIONS.

T.—Tasmania.
W.A.—Western Australia.
S.A.—South Australia.
Q.—Queensland.
N.S.W.—New South Wales.
V.—Victoria.
N.Z.—New Zealand.
E.—Europe.

NOTE.—The last column in the accompanying Table o Distribution refers to the number of the Species under each Group in the preceding list. (R.M.J.)

WORTS.

				—	—		50
			—	—	—		51-52
On falle			—	—	—		53
		—	—	—	—		54-55
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In sh			—	—	—		57
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In n			—	—			11
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Bott							1
							2
							3
Moss							4
							5
							6

THE DISCOVERY OF VAN DIEMEN'S LAND IN 1642; WITH NOTES ON THE LOCALITIES MENTIONED IN TASMAN'S JOURNAL OF THE VOYAGE.

BY JAMES BACKHOUSE WALKER.

ABEL Janszoon Tasman was unquestionably one of the greatest, if not the greatest, of the navigators between Magellan, who in the early years of the 16th century first crossed the Pacific Ocean, and Cook, who in the latter years of the 18th practically opened Oceania and Australia to Europe.

Little is known of Tasman's personal history, except that he was born about the year 1602, at Hoorn on the Zuyder Zee, a seaport which produced many another hardy navigator. Tasman has made familiar in our seas the name of one of these fellow townsmen, the Cornelis-zoon Schouten, who in 1616 doubled the Cape, afterwards called the Horn in honour of the birthplace of its discoverer.

That Tasman's merit has not received due recognition, and that his fame has not been as wide as his achievements deserved, is the fault of his own countrymen. In the 16th and 17th centuries the persistent policy of the Dutch was to conceal the discoveries of their navigators, and suppress their charts, for fear other nations should reap advantage from the knowledge and rival them in the eastern seas. In later times when this motive had lost its force, Tasman's countrymen were strangely indifferent to the honour which their great sailor had won for his native land. Of his second voyage in 1644–in which he explored the northern coast of Australia, and laid down with painstaking accuracy the shores of the Gulf of Carpentaria —we have to this day only meagre hints and the record contained in a sketch map. Of his more famous voyage to the Great Southland in 1642—in which he discovered Tasmania and New Zealand, and made a great step towards solving the vexed problem of the fancied Terra Australis—the journal remained unpublished for more than two centuries. It is true that a short abstract of this voyage was published in Holland late in the 17th century, and was shortly afterwards translated into English, and included in several collections of voyages made by English and French editors, and that Valentyn, in his great work on the Dutch

East Indies published in 1726, gave a more extended account, illustrated by copies of Tasman's maps and sketches. But the journal itself remained practically unknown until a copy of it and of the original sketches and charts was discovered in London in 1776 and purchased for half a guinea. This MS. afterwards came into the possession of Sir Joseph Banks, and he employed the Rev. C. G. Woide, a Dutch clergyman living in London, to make a translation of it. Thirty years later the substance of this translation was printed by Dr. Burney in his "History of Discovery in the South Sea," published in 1814. Woide's MS. is now in the British Museum, and a verbatim copy of the part relating to our island has lately been made by Mr. Bonwick for the Tasmanian Government. In Tasman's own country his original journal remained neglected for more than two centuries, until in the year 1860 it was printed *in extenso* at Amsterdam under the editorship of Mr. Jacob Swart.*

Tasman's expedition was probably the first systematic attempt made by the Dutch to explore the Great South Land. In the early years of the 17th century the Western Coast of Australia had been several times sighted by Dutch Captains. Ships, bound for the Dutch settlements at Batavia, had been driven to the southward by storms, and the resulting discoveries had, therefore, been to a large extent involuntary, or at least accidental. In the year 1642, however, the Governor-General, Anthony Van Diemen, and the Council of Netherlands-India, determined to despatch from Batavia a properly equipped expedition, having for its sole object the discovery of the Great Southern Continent. The instructions to the commander, prepared by their direction, have been preserved. They contain a detailed statement of all that was then known by the Dutch of the geography of those parts, and they prescribe the course that the ships were to pursue. The command of the expedition was entrusted to Tasman, then 40 years old, and the ship *Heemskirk* was assigned to him for the service, with the little fly-boat *Zeehan* as tender. Tasman sailed from Batavia on August 14; reached Mauritius (then a Dutch settlement) on September 5, and sailed thence for the South on October 5. He held a S.E. course until on November 6 he had reached 100deg. E. long. in lat. 49deg. S., without finding any signs of the supposed continent. A council of officers was held, and the chief pilot, Francis Jacobsen, advised that the course should be altered, and that the ships should make for lat. 44deg. S. until 130deg. E. long. was reached, when, if no mainland was meet with, they should sail into 40deg. S. lat., and steer on that parallel until they reached 200deg. E. long. By this course he thought they would be sure to fall in with islands, and having so far solved the problem of the great southern continent, he advised that they should stand north for the Solomon Islands, whence they might shape their course for home. By the middle of November they came to the conclusion that they had passed the extreme limits of the supposed continent, but on the 24th of the month land was seen bearing east by north, distant 10 Dutch miles (40 miles English.) Unlike the invariable low sandy shore which former captains had described as characteristic of the Great Southland, the country before them was mountainous, and clothed with dark forest. Tasman says: "This is the furthest land in the South Sea we met with, and as it has not yet been known to any European we called it Anthony Van Diemen's Land, in honour of the Governor-General, our master, who sent us out to make discoveries. The islands round about, as many as were known to us, we named in honour of the Council of India." They skirted the newly-discovered land, and on December 1 came to an anchor in a bay on the east coast. On December 3 they weighed anchor and sailed north until they reached a point about St. Patrick's Head, from whence they stood away eastward to make new discoveries. After eight days they sighted land, which Tasman called Staten Land, thinking that it might be part of the Southern continent and joined to Staten Land, east of Tierra del Fuego. (When this supposition was shortly afterwards shown to be an error,* the name was changed to that of New Zealand.) After a fatal encounter with the Maoris, Tasman sailed along the west coast of New Zealand to Cape Maria Van Diemen, and thence took a north-east course, discovering Amsterdam and other islands, and after skirting the north coast of New Guinea, he returned to Batavia. In his second voyage in 1644, Tasman again sailed from Batavia and explored the west, north-west, and north coasts of Australia, the Gulf of Carpentaria, and the south coast of New Guinea. Thus in the two voyages, though he left the question of the existence of a southern continent still unsolved, he had made the first complete circumnavigation of Australia and New Guinea.

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* Journaal van de reis naar het onbekende Zuidland in den jare 1642, door *Abel Jansz.* Tasman; medegedeeld door Jacob Swart. Amsterdam, 1860.

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* By the voyage of Brouwer round Cape Horn in 1643.

We may now turn our attention to identifying the parts of the coast of our island which were sighted by Tasman. The difficulty is that his longitudes are very uncertain, and his latitudes, though less variable, do not agree with modern observations, being in general some 9 or 10 miles too southerly.* His longitudes are quite hopeless. Their uncertainty is shown by the fact that he makes a difference of 3 deg. 40 min. between the west coast and Frederick Henry Bay, while the true difference is only 2 deg. 48 min.—an error of 52, or nearly a degree in that short distance. Many of his positions are stated to have been estimated by reckoning, and we know that in those days the ascertainment of longitude by observation was always very uncertain.

It is generally stated that the first land sighted by Tasman was near Point Hibbs, and his little chart of Van Diemen's Land appears to favour this opinion, but an examination of his journal leads us to a different conclusion. From the entries in the journal it is evident that his position on November 24, when he first saw the land, is not laid down on the chart at all. The latitude entered for noon that day is 42 deg. 25 min. As the weather was clear this was probably the observed latitude, and making allowance for the usual error we may place it some miles more to the north, say 42 deg. 20 min. or 42 deg. 15 min. From noon he sailed four hours E. by N. before he sighted land bearing E. by N. 40 English miles distant. When evening fell some three hours later this course would have brought him to a latitude a little to the northward of Cape Sorell (42 deg. 12 min.) This position would agree very well with his description of the land as he saw it on that evening, and which he describes as "very high." "Towards evening we saw three high mountains to the E.S.E. and to the N.E. We also saw two mountains, but not so high as those to the southward."

Flinders in his circumnavigation of the island identified the two mountains to the N.E. as those named by him Heemskirk and Zeehan after Tasman's ships. They are visible at about 30 miles distance. Now with Heemskirk and Zeehan bearing N.E., at a distance of say 20 miles, Mount Sorell, the southern peaks of the West Coast Range, and the Frenchman's Cap, would be nearly E.S.E., while the centre of the West Coast Range seen over the low sandy foreshore north of Macquarie Harbour would fit Tasman's description of the very high land in front of him. If the land near Point Hibbs had been first sighted, Mount Heemskirk would have been at least 50 miles distant, and not visible. It is therefore probable that the first land seen by the Dutch navigator was the mountainous country to the north of Macquarie Harbour. Without further observations the point must remain doubtful, but when we get the much-needed and long-expected Admiralty survey of the West Coast it will doubtless be possible to fix precisely the spot of Tasman's landfall.

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* This conclusion is reached by a comparison of the latitudes shown on his chart for his anchorage on the east coast, for Maria Island, the Friars, and Maatsuyker Island. On the other hand he gives the latitude of the point where he approached close to shore as 42 deg. 30 min., the true latitude of *Point Hibbs* being 42 deg. 38 min.

When the shades of evening fell over the strange shore they had just discovered it was deemed prudent to run out to sea during the night, and when morning broke the land was far distant. The breeze had died away, and it was noon before they had enough wind to run in again towards the shore. By 5 in the evening they were within 12 miles of the land, and they kept on their course until within one Dutch mile (4 English miles) of what was without doubt Point Hibbs.

This was the opinion of Flinders, than whom there could be no higher authority on such a question, and Tasman's sketch, rough as it is, seems conclusive. Point Hibbs is there laid down as an island, but its distinctive form—unlike any point lying to the northward—is correctly shown.[*]

The ships stood out to sea again and sailed south-east in thick, foggy weather, in which only glimpses of the coast were obtained. Tasman took some of the high headlands and mountains about Port Davey for islands, calling them De Witt and Sweers Islands. Then he rounded the South West Cape, and named the Maatsuyker Islands, passing close to a small island about 12 miles from the mainland which looked like a lion, and which was indentified afterwards by Flinders as the rock named by Furneaux the Mewstone. Thence he passed between the mainland and a rock which he named Pedra Branca[†] (White Rock) from its resemblance to Pedra

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[*] The only difficulty in reconciling the positions of the two days (Nov. 24 and 25) lies in the fact that the difference of latitude given in the journal is 5 min. only. The difference of latitude between Cape Sorell, where we suppose him to have been on the first evening, and Point Hibbs, where he certainly was on the second, is 26 miles. The discrepancy may, however, be accounted for. On the second day they had southerly wind and thick weather, and probably got no observation. They had been standing off and on for 24 hours, and currents unknown to them would probably lead to error in estimating their position. The probability of error in Tasman's latitude is increased by the fact that he makes the latitude 42 deg. 30 min. instead of 42 deg. 38 min., the error being too northerly instead of too southerly, as usual.

[†] Known to our fishermen as "Peter's Bank."

Branca off the coast of China, and sailed past the entrance of D'Entrecasteaux Channel without entering it, though in his chart he marks an opening in the coast. Rounding the Friars (which he called Boreels Isles) on November 29 he bore up for a large bay, intending to anchor there. When he had almost reached his intended anchorage[*] a heavy storm arose, and he was driven out so far to sea that next morning he could hardly discern the land. It was from this incident that Storm Bay got its name. When the wind moderated he continued his easterly course, and rounding Tasman's Island (the Pillar) he turned northward along the east coast of Tasman's and Forestier's Peninsulas until, on December 1, an hour after sunset, he came to an anchor in a good port in 22 fathoms, the bottom fine, light-grey sand. "Wherefore," says Tasman piously, "we ought to lift up thankful hearts to Almighty God." The position of this anchorage, as shown in Tasman's chart, is north-west of the rocky islet now called Green Island, just north of the basaltic cliffs of Cape Frederick Henry.

On December 2, early in the morning, the boat was sent to explore, and entered a bay a good 4 miles to the north west (Blackman's Bay). The boat was absent all day, and returned in the evening with a quantity of green stuff which was found fit to cook for vegetables. The crew reported that they had rowed some miles after passing through the entrance to the bay (now known as the Narrows). They had heard human voices, and a sound like a trumpet or small gong (probably a cooey), but had seen no one. They saw trees from 12 to 15 feet round, and 60 to 65 feet up to the first branch. In the bark of these trees steps had been hacked with a flint for the purpose of climbing to the birds' nests. From the steps being five feet apart they inferred that the natives were either very tall[†], or had some unknown method of climbing. The forest was thin and unencumbered by scrub, and many of the tree trunks were deeply burnt by fire. In the bay were great numbers of gulls, ducks, and geese. At various times during the day both the boats' crews and the people on board the ships had seen smoke rising from different points on shore, "so that without doubt in this place must be men, and these of uncommon height."

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[*] The anchorage he aimed at was the same where Furneaux anchored in 1773, and which he named Adventure Bay.

[†] The early navigators had a fixed idea that these southern lands were inhabited by giants. At the Three Kings, north of New Zealand, Tasman describes the men they saw walking on the shore as being of gigantic stature.

The next day (Dec. 3) the boats went to the south-east corner of the bay in which the ships were anchored, in order to get fresh water, but, though they found a lagoon, the shore was so low that the waves had broken through, and the water was too brackish for use. The wind blew strongly from the east and south-east, and in the afternoon, when they again tried to effect a landing with the boats, the sea ran so high that one boat was obliged to return to the ship. The other larger boat, under the command of Tasman himself, made for a little bay to the W.S.W. of the ships, but the sea was too rough to allow of landing. The carpenter, Peter Jacobsen, volunteered to swim ashore with a pole on which was the Prince's flag. He planted the flag-pole in the ground on the shore of the bay, and thus Tasman took possession of our island for the Dutch.

Next morning at daybreak (Dec. 4), the storm having subsided, and the wind blowing off shore, they weighed anchor and stood to the northward, passing Maria Island and Schouten Island, so named by Tasman after his fellow-townsman of the good port of Hoorn.

On the following morning (Dec. 5) he took his departure from a high round mountain (St. Patrick's Head) and stood away to the eastward to make fresh discoveries.

Of the localities associated with the discovery of this island, the one round which the chief interest centres is Frederick Henry Bay and its neighbourhood. The name has been dislocated from its rightful position on the map, and has been transferred to another part of the coast, where it is now fixed by long usage. Tasman never saw what is now popularly known as Frederick Henry Bay. The bay to which he gave the name of the Stadtholder of Holland was in the immediate vicinity of his anchorage on the north-east coast of Forestier's Peninsula. Its exact locality the records of the voyage leave a little doubtful. The journal contains no names of places, but the account of the planting of the flag would lead to the inference that he gave the Prince's* name to the bay in which his ships lay at anchor, on the shore of which the Prince's flag was set up, and which is now known as Marion Bay. The charts, however, lead rather to the conclusion that it is the inner port or arm of the sea (now Blackman's Bay) which is the true Bay of Frederik Hendrik. The copy of the map in Burney leaves the point doubtful, the name being written on the land between the two ports. But in the chart as reproduced by Vallentyn, and stated to have been copied by him from the original journal, the name is distinctly written in Blackman's Bay. On the whole, therefore, it seems probable that this is the Frederik Hendrik Bay of Tasman.

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* Prince Frederik Hendrik of Orange was Stadtholder of Holland from 1625 to 1647. He was the grandfather of William of Orange, afterwards William III. of England.

The eastern shore of Forestier's Peninsula is wild and rugged, and scarcely known except to the hardy fishermen who, in their trips northward along the coast, fish in its quiet nooks, or run for shelter into the beautiful inlet of Wilmot Harbour. With the exception of a solitary shepherd's dwelling on the shore of this harbour—locally known as Lagoon Bay—the eastern part of the Peninsula is uninhabited, and so difficult of access that it is seldom visited. In the early part of 1889 I had an opportunity of thoroughly exploring a locality which must always be of interest as the spot where the sailors of the great Dutchman first set foot on the island which bears his name.

Our party—which included my friend Mr. R. M. Johnston—left East Bay Neck in a fishing-boat to camp at Chinaman's Point just within "The Narrows," or entrance of Blackman's Bay. During the time of our ten days' camping we cruised in our boat over the great bay outside, seeing the coast from the point of view which Tasman occupied when the *Heemskerk* lay at anchor off rocky little Green Island. We could thus realise the scene, unaltered after two centuries and a half, which presented itself to the old navigator when he caught his first near view of the picturesque shores of this outpost of the Great South Land, the mysterious continent of his search. To the south stood the jutting basaltic columns of Cape Frederick Henry—a lesser Cape Raoul—backed by the high round of Humper's Bluff. Thence his eye travelled northward round twenty miles of curving shore, its white beaches broken here and there by dark cliffs and rocky points. On the north, beyond the long stretch of white sand barring Blackman's Bay, rose steep-wooded hills, buttressed at their eastern end by the abrupt mass of Cape Bernier, thrusting its almost precipitous slope into the ocean, and flanked by the hills of Maria Island, shutting in the great bay on the north-east. The coast view from the offing is fine, but if the visitor wishes to appreciate fully the picturesqueness of the shore, and to identify the spots mentioned in the quaint old Dutch journal, he must be prepared for some rough scrambling on the Peninsula itself. The country inland is poor, almost without water, covered with thin gum forest, scrub, and meagre grass. It is only the shore that is interesting. The rocky headlands, cliffs, and islands, against which the ocean dashes, are rent and scarred by sudden fissures and chasms, into which the waves rush roaring and tumbling. Between the points lie a variety of lovely bays; now a broad white beach with long rollers of breaking surf, now a rocky nook, now a quiet and sheltered cove.

Our centre of observation was the camping ground within The Narrows, from whence we looked out over the broad expanse of Blackman's Bay. This extensive inlet or arm of the sea is shallow and full of shoals and sandbanks, which make the navigation even of a boat dangerous to the inexperienced. It is shut in from the sea by a long tongue of land and by shoals, leaving only a small outlet very appropriately called "The Narrows," through which the tide rushes with great force. Early on the first morning after the ships had come to an anchor the two boats, under the command of Pilot Francis Jacobszoon, rowed through this narrow inlet to explore the new-found country. The pilot's description of the watering places where the water trickled so slowly that they could with difficulty fill a bowl is thoroughly characteristic of the eastern shores of Blackman's Bay. In the evening Pilot Jacobszoon returned on board with his collection of strange vegetables, and his report of the well-wooded country, the great trees scarred by fire, with marks on their bark of the steps of gigantic climbers, whom they had not seen, but whose mysterious voices they had heard.

The various localities mentioned in Tasman's journal were easily reached from our camp. Outside "The Narrows" the shore rises in high cliffs, at the foot of which a broad rocky shelf affords access to little nooks, which, in the early days of the colony, were the sites of stations for bay whaling, and are still known as Gardiner's and Watson's Fisheries. Some two miles from The Narrows is Cape Paul Lamanon. A fishing excursion to the neighbourhood gave me an opportunity of landing on the Cape. It is a low point, the soil of which is stony and arid, covered with small timber and rough scrub. From the Cape a short walk took me to the little cove marked on the maps as Prince of Wales Bay. It was on the shore of this little cove (cleene bochtien), situated to the west-south-west of Tasman's anchorage, that the Dutch flag was planted two centuries and a half ago. The shores of the bay on each side of the entrance are rocky and broken, but further in the rocks give place to a beach of large grey shingle. As you advance along the shore up the bay the banks of shingle on each side curve into two horns shelving out towards the centre of the bay, and forming a bar extending nearly the whole way across the entrance to the inner cove. Within the bar of shingle lies enclosed a lovely cove, its quiet waters fringed by a curved beach of great smooth stones. On either hand it is shut in by steep banks crowned with dark forest, and from the steep grey beach at the bottom of the cove a wooded valley runs inland. Standing just outside the shingle bar at the entrance to this inner harbour it needs no great effort of the imagination to call up the scene on that 3rd December, 1642. Away out in the offing, near yonder grotesquely shaped Green Island, the high-pooped old Dutch ships lie at anchor. The wind is blowing fresh from the eastward, and two boats put off from the ships and stand for the shore. The wind increases to half a gale, and while the smaller boat runs back to the ships the larger boat changes her course and heads for this bay. As she approaches we can see on board of her Tasman himself, and some of the *Heemskerk's* officers; Gerrit Janszoon, the master; Abraham Coomans, the supercargo; and Peter Jacobszoon, the carpenter. The surf breaks violently on the shingle, and Tasman finds that to land in such a sea is impossible without great danger of wrecking the boat. Must he, then, after all, sail away without taking formal possession of the newly-discovered land? There is a short deliberation as the rowers rest on their oars, and then the carpenter, Jacobszoon, hastily throws off his clothes, plunges into the sea, and, pushing his flag-pole before him, strikes out for the shore. Making his way through the breaking surf he lands on the shingle beach, and there, at the foot of the steep slope, where four stately gums stand in a crescent on the hill side, he plants the flag of the Prince Stadtholder. We can imagine the cheer which greeted the raising of the flag as the carpenter, in the name of the States-General, thus took possession of the new territory of the Great South Land. Then the boat is brought as close in to the shore as possible, the carpenter swims out to her again through the surf, and they return on board the *Heemskerk*. "Leaving the flag," says Tasman, "as a memento to posterity and to the inhabitants of the country, who, though they did not show themselves, we thought were not far off, carefully watching the proceedings of the invaders of their territory."

Another place of interest on this coast to which we paid a visit is Wilmot Harbour, locally known as Lagoon Bay, a deep cove to the south of the basaltic promontory of Cape Frederick Henry. Here is the one solitary dwelling on this part of the Peninsula. It is probably the only locality which has altered much in appearance since the time of Tasman. Everywhere else the wild bush remains untouched, but here is green pasture, and even a small cornfield or two. The southern headland of the harbour is one of the wildest and most picturesque of spots. Standing on the grassy surface of its narrow extremity, which is rent into chasms and fissures, you look down upon the sea breaking tumultuously into a deep gulf below. On the other side of the gulf, to the south, there rises abruptly out of the water the grassy and wooded steep of a headland, with bold outline like Mount Direction. Turning to the north you see at your feet two rocky islands, their precipices crowned with wood and scrub, the waves heaving and swirling round their bases. Across the mouth of the harbour stand the basaltic columns of Cape Frederick Henry—a lesser Cape Raoul. Beyond, over outlying rocks and islets, is the place of Tasman's anchorage; while in the distance, twelve or fifteen miles off across the sea, loom the peaks of Maria Island.

On our return we took the way of the Two Mile Beach (the North Bay of the maps). Behind the sandhills at the back of the beach lies a large lagoon, which discharges its brackish waters by a narrow sandy channel at the south corner of the beach. This is the spot where Tasman's boat's crew landed—on the morning after their exploration of Blackman's Bay—to search for water, and where they found that the sea breaking through into the lagoon had made the water too brackish for use. The spot is easily identified from Tasman's description, and is probably hardly altered in appearance by the lapse of two centuries and a half. The beach is a fine stretch of broad white sand two miles long, on which the great ocean rollers break splendidly, and is backed by a line of low sandhills, behind which lies the lagoon.

For more than a century after Tasman anchored off Green Island no navigator ventured to follow him into the stormy seas that wash the dark cliffs of the Great South Land. The first of the moderns who sighted the coast of Van Diemen's Land was the French captain Marion du Fresne in 1772. Marion made the West Coast a little to the south of Tasman's landfall, and, following almost the same course as the earlier navigator, his ships, the *Mascarin* and *Marquis de Castries*, on the 5th March, 1772, anchored at a spot somewhat to the north-west of the *Heemsherk's* anchorage in 1642. Marion took this to be the Frederick Henry Bay of Tasmania, but, as we have already seen, this was almost certainly an error, and since the visit of the *Mascarin* the outer bay, as distinguished from the inner, has borne on the charts the more appropriate designation of Marion Bay. The description in the narrative of the voyage[*] is not sufficiently exact to enable us to determine the precise spot where the French landed, but it appears to have been on the Two Mile Beach (North Bay of our present maps). On this beach it was that the aborigines of Tasmania first came into contact with Europeans. The meeting was an ill-omened one. The blacks resisted the landing, and attacked Marion's party with stones and spears. The French, in retaliation, fired upon them, killing one man and wounding others. The ships lay at anchor in the bay for six days, during which the French explored the country for a considerable distance, searching for fresh water and timber for spars, but they saw nothing more of the natives after this first fatal encounter. Being unable to find either good water or timber suitable for his needs, Marion sailed on March 10 for New Zealand, where he met his death in a treacherous attack on his people by the Maoris.

The next navigator who visited the Tasmanian coast was Captain Tobias Furneaux, Cook's second in command on his second voyage of discovery. It is to Furneaux's blunders that the confusion respecting Frederick Henry Bay is due. The two ships, the *Resolution* and the *Adventure*, were separated by a storm in latitude 50° south, between the Cape and Australia. Cook, in the *Resolution*, kept on his course for New Zealand; Furneaux, in the *Adventure*, being short of water, bore up for the land laid down by Tasman as Van Diemen's Land. On March 9, 1773, Furneaux sighted the land at a point which he took to be Tasman's South Cape. The point was, in fact, South West Cape, and from this initial error the whole course of subsequent blunders arose. From South West Cape he sailed eastward intending to make Tasman's anchorage in Frederick Henry Bay. Reaching the South Cape, he mistook it for the Boreel Islands, south of Bruny, and mistook the entrance of D'Entrecasteaux Channel for Tasman's Storm Bay. The south point of Bruny he mistook for Tasman's Island (the Pillar), and called it Tasman's Head. Rounding Bruny Island he stood north, under the impression that he was sailing along the east coast of Van Diemen's Land, and in the evening came to an anchor in a bay of which he says—"We at first took this bay to be that which Tasman called Frederick Henry Bay, but afterwards found that his is laid down five leagues to the northward of this." Furneaux named his anchorage Adventure Bay, the point to the north he called Cape Frederick Henry—believing that Tasman's Frederick Henry Bay lay to the north of this cape—and the opposite shore of Tasman's Peninsula he laid down on his chart as Maria's Isles. After five days' stay in Adventure Bay, he sailed out and rounded the Pillar, under the impression that he was rounding the south point of Maria Island. Thence he proceeded north as far as the Furneaux Group, and then bore away for New Zealand to rejoin Cook.

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[*] Nouveau voyage à la mer du Sud, commencé sous les ordres de M. Marion Redigé d'apres les journaux de M. Crozet (Paris, 1783). Through the exertions of Mr. McClymont and Mr. A. Mault, Marion's charts of Van Diemen's Land have been discovered in Paris, and *fac similes* of them obtained. See the *Society's* Papers and Proceedings for 1889.

Cook, on his third voyage, cast anchor in Adventure Bay on January 24, 1777, without detecting Furneaux's mistake or correcting his charts.

In 1789, Captain J. H. Cox, in the brig *Mercury*, anchored in the strait between Maria Island and the mainland, but, misled by the charts of Furneaux and Cook, never suspected that he was within a few miles of Tasman's Frederick Henry Bay.

In April, 1792, Admiral D'Entrecasteaux, with the ships *Recherche* and *Esperance*, sighted the Mewstone and bore up for the mainland, intending to make Cook's anchorage in Adventure Bay. Through an error of his pilot, instead of rounding Bruny Island, he stood to the west of it, and found that he was not in Adventure Bay, but in the entrance of the Channel, which he (like Cook) believed to be the Storm Bay of Tasman. D'Entrecasteaux explored the channel which bears his name, ascended our river, which he named Rivière du Nord, and explored the wide bay to the north-east, which he named Baie du Nord. This bay he thought, communicated with Tasman's Frederick Henry Bay on the east coast, and under this impression the land which Cook had erroneously laid down as Maria Island he named Ile d'Abel Tasman.

In 1794, Capt. John Hayes, in the ships *Duke of Clarence* and *Duchess*, visited Storm Bay—although the name does not appear on his charts.* He evidently had only Cook's chart, since he places Adventure Bay, Tasman's Head, and Maria's Iles as they are laid down by Cook. Capt. Hayes re-named all the other localities in Storm Bay, and it is to him that we owe the name of the River Derwent. The Baie du Nord of D'Entrecasteaux he called Henshaw's Bay.

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* See Mr. A. Mault's paper, with *fac simile* of Hay's chart, in the Society's Papers and Proceedings for 1889.

In December, 1798, Flinders and Bass, in their first circumnavigation of the Island in the *Norfolk*, sailed up Storm Bay and explored and surveyed the Baie du Nord of D'Entrecasteaux. Flinders says that he was at the time quite ignorant that this bay had ever been entered before, and, misled by the errors of Furneaux and Cook, he laid it down on his first sketch chart[*] as Frederick Henry Bay.

In January, 1802, the French discovery expedition under Admiral Baudin, in the ships *Géographe* and *Naturaliste*, arrived in D'Entrecasteaux Channel. During a stay of some weeks they completed the surveys of Admiral D'Entrecasteaux, and explored and surveyed the Baie du Nord. They then sailed for the east coast and anchored their ships in the passage between Maria Island and the mainland. From this point Freycinet, Baudin's lieutenant, made the first thorough examination of Tasman's Frederik Hendrik Bay. He explored it as far as East Bay Neck, and was thus enabled to correct the mistakes of former navigators. He found that D'Entrecasteaux had been mistaken in supposing that there was a channel between Frederick Henry Bay and the Baie du Nord, and that the supposed Ile d'Abel Tasman was a double peninsula, to which he gave the names of Forrestier's and Tasman's Peninsula (Presqu'ile d'Abel Tasman). He also proved that Flinders[†] had been in error in applying the name Frederick Henry to the Baie du Nord. The charts of Baudin's expedition, constructed by Faure, were the first to show this coast accurately: in them for the first time the outer port was laid down as Baie Marion, and the inner one as Baie Frédérick Hendrick.

Many years later, after his liberation from his long Mauritius captivity, Flinders came to write his "Voyage to Terra Australis." He had then had the opportunity of comparing his own surveys of fifteen years before with the French charts, and correcting his errors. In his atlas, therefore, the Baie du Nord is correctly named

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[*] See Mr. Mault's paper and *fac simile* of chart, cited above.

[†] Peron's narrative of Baudin's voyage was published in 1807. The author had, therefore, the opportunity of comparing Flinders' charts which were *seized at* the Mauritius in 1803.

North Bay, and the name of Frederick Henry Bay is restored to its proper place on the east coast; though Flinders applies it to the outer port and not to the inner which bears the name on Tasman's map.

The original error of Furneaux, perpetuated as it was by the high authority of Cook and of Flinders' first chart, had obtained too firm a hold to be displaced. On all the early English charts the Baie du Nord was laid down as Frederick Henry Bay, and by this name it is alluded to in all the early records; in Collins' despatches;* in Knopwood's diary;† as such it continued to be known to the early settlers, and so it is universally known to the present day.

After the publication of Flinders' atlas some of the early map-makers endeavoured to restore the names to their proper localities. Thus in a chart of Van Diemen's Land compiled by G. W. Evans, Surveyor-General, and published in London in 1821, and also in a chart published in London by Cross in 1826, North Bay is correctly placed, and the name Frederick Henry is in the first map applied to the outer bay, and in the second more correctly to the inner one. In Assistant Surveyor-General Scott's map published in Hobart by Ross in 1830, the name Frederick Henry appears in North Bay, but in Arrowsmith's map published in London in 1842, the alternative names are given, viz.:—Frederick Henry Bay *or* North Bay; while the name Frederick Henry also appears correctly in the inner bay to which it was originally applied by Tasman. In all modern maps, however, D'Entrecasteaux' name of North Bay has been most inappropriately transferred to what I have described as the Two Mile Beach, on the east coast of Forestier's Peninsula.

The Fredrik Hendrik Bay of Tasman is now known as Blackman's Bay. On early maps the name of Blackman's Bay is applied sometimes to the Two Mile Beach, and sometimes to Wilmot Harbour. By what freak of the map-makers of our Survey Department these names have been shuffled about so oddly I am quite at a loss to imagine.

The names as they stand are perhaps now too firmly established to be changed at once. But I would venture to offer to the Lands Office two suggestions:—

(1) As there is already a Cape Frederick Henry on the east coast of Forestier's Peninsula, which rightly marks Tasman's anchorage, a more appropriate name

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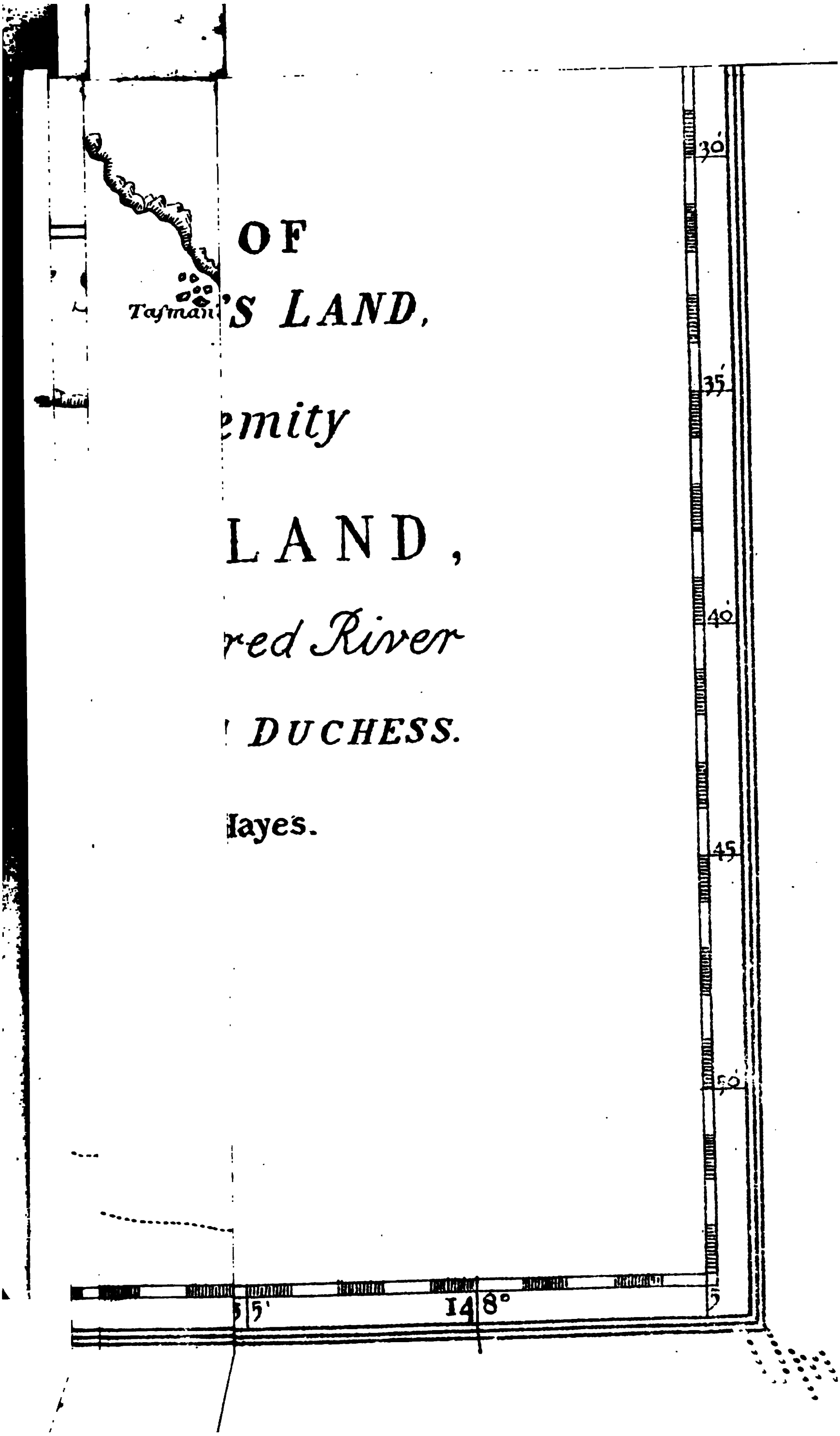
* King to Collins, January 8, 1805; Collins to King, June 24, 1805

† Knopwood's diary, February 12, 1804.

should be given to the other Cape Frederick Henry, forming the north point of Adventure Bay on Bruny Island. Let the last-mentioned Cape bear the name of its discoverer, and be rechristened "Cape Furneaux." This would remove one source of misapprehension.

(2) Though it may not be possible at once to restore the correct names of the bays, yet they may be indicated without causing confusion, and indeed with distinct advantage to the popular apprehension of our history. In all future maps let the names originally given be added in brackets. D'Entrecasteaux Baie du Nord would then appear as "Frederick Henry Bay *or* North Bay," and in Blackman's Bay would also be added "Fredrik Hendrik's Bay of Tasman."

Thus to perpetuate the remembrance of the landing-place of Tasman would be a graceful act of justice to the memory of the great seaman who, two centuries and a half ago, first circumnavigated Australia, and has given his illustrious name to this fair island of Tasmania.



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REPORT

OF THE

ROYAL SOCIETY

OF

TASMANIA

FOR THE YEAR

1890.

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1891.

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* Ross, J., Clunes, B.Sc., F.G.S., &c., Bathurst, N.S.W.

Salier, Frederick J.
Seal, Matthew.
Sharpe, John.
Shaw, Bernard.
* Shoobridge, W. E., New Norfolk.
Shoobridge, R. W. G., New Norfolk.
* Shortt, J., Capt., R.N.
Simmons, Rev. J. Wilkes.
Simmons, M. W.
* Simpson, Augustus, Launceston.
† Solomon, Joseph.
* Stephens, Thomas, M.A., F.G.S.
* Swan, Edward D.
Syme, J. Wemyss.

Tabart, T. A.
Taylor, A. J.
* Thureau, G., F.G.S., Launceston.
Thompson, Rev. E. H. T., Huon.
Toplis, W. J.
Tottenham, Major-General.

Turnbull, T.
Triffit, J. T., Ouse.
* Travers, S. Smith.

Walch, Chas. E.
Walch, James H. B.
* Walker, James Backhouse.
Wallack, E.
* Ward, W. F.
Waterhouse, George Wilson, B.A., Launceston.
* Webster, Alex. G.
Weymouth, W. A.
Wilson, Edward P.
Wise, Fred. H.
* Woollnough, Rev. J. B. Williams, M.A.
Wright, Howard.

Young, Russell.
Young, F. J., B.A.
Young, F.M.

MINUTES of the Annual General Meeting of the ROYAL SOCIETY OF TASMANIA, *held at the Museum on Friday evening, 12th March, 1891,—Mr.* JAMES BARNARD, *Vice-President, in the Chair.*

NEW MEMBERS.

Mr. J. J. Walker, R.N., Chief Engineer of the *Penguin*, was elected a Corresponding Member.

Captain P. R. H. Parker, R.N., and Messrs. E. Watchorn, John Brown, and Montague Jones were elected Fellows.

THE ANNUAL REPORT.

The Secretary (Mr. A. Morton) read the Annual Report.

Sir Lambert Dobson moved—That the Report now read be adopted, printed, and circulated among the Fellows of the Society. He said that the Report really spoke for itself; but in the slight reference he would make to it he would like to say one word in reference to the great interest taken in the progress of the Society by His Excellency the Governor. He thought that, in the absence of Sir Robert Hamilton, they might very fairly pay a tribute to the generous and warm interest he had taken in the Society. His Excellency had hardly ever failed to be present, and he had not only manifested a personal interest, but had given the Society, as a present, a very valuable work. They were also indebted to those gentlemen whose names appeared as having read papers at the meeting of the Society, their only regret being that they had not a larger number of contributors, and the work distributed over more shoulders. He thought that they had reason for congratulation at the progress of the Society, both numerically and financially, and he had no doubt but that much of that success was due to the Secretary. He mentioned that gentleman specially because he had worked hard, and done good work for the Society. He believed that there was much to be done in the walks of science here. A naturalist on board H.M.S. *Penguin* had discovered many species of new insects since the ship had been in the harbour, and doubtless many more might be discovered if there were in our midst those who followed such pursuits.

Mr. F. Jacobs seconded, and the motion was passed.

Mr. E. D. Swan moved—That the Hon. J. W. Agnew, M.D., His Honor Sir Lambert Dobson, Messrs. Russell Young, and C. H. Grant, the retiring Members of the Council, be re-elected; also that Messrs. Francis Butler and John Macfarlane be re-elected as Annual Auditors.

Mr. F. Abbott seconded, and the motion was passed.

Mr. Francis Abbott moved—That a vote of thanks be accorded to Messrs. Butler and Macfarlane for their kindness in acting as Auditors during the year.

Mr. A. W. Gosnell seconded, and the motion was agreed to.

Mr. C. H. Grant moved—That a vote of thanks be accorded to the Press for their valuable services in publishing such full and accurate notes of the Society's proceedings.

Dr. Bingham Crowther seconded, and the motion was agreed to.

This finished the business.

REPORT.

The Council of the Royal Society of Tasmania have much pleasure in submitting the following Report for 1890 :—

The first monthly meeting took place on April 22nd, when the President, His Excellency Sir R. G. C. Hamilton, K.C.B., occupied the chair. The attendance of Fellows, including several ladies, was large. Mr. James Barnard gave an account of the visit of the Representatives of this Society to the Melbourne meeting of the Australasian Association for the Advancement of Science. Mr. J. B. Walker read an interesting paper on the " Discovery and Occupation of Port Dalrymple." Mr. R. M. Johnston presented a joint report from himself and Mr. A. Morton on a ganoid fish from the lower mesozoic sandstones near Tinder Box Bay ; and Mr. A. Durrand, F.R.M.S. London, exhibited a series of fine microscopical preparations of foraminifera and other minute organisms dredged from depths of from five fathoms to two miles, near the coasts of the Hawaian Group, Java, the Channel Islands, Ireland, &c. The number of papers read during the session was twenty-three. The subjects were :—

By Mr. J. B. Walker.

1. "The Discovery and Occupation of Port Dalrymple."
2. " An Account of the last Antarctic Expedition."
3. " Notes on the localities mentioned in the Journal of Tasman's discovery of Tasmania."

By Mr. R. M. Johnston, F.L.S.

4. " Description of a second Ganoid Fish from the mesozoic sandstones near Tinder Box Bay."

5. "Further observations upon the Fishes and Fishing Industries of Tasmania, together with a revised list of indigenous species."
6. "Root matters in Social and Economic Problems."
7. "Provisional aid to the study of the Tasmanian Mollusca."
8. "Notes on a Fern new to Tasmania *(Blechnum cartaligenum.)*"
9. "Observations on the influence of Strikes upon Real Wages."
10. "A rejoinder to Mr. A. J. Ogilvy's paper, entitled 'Can the toiling masses really improve their condition by Strikes?'"

By Mr. E. C. Nowell.

11. "Do the changes of the moon affect the rainfall?"

By Captain Shortt, R.N.

12. "A rejoinder to Mr. Nowell's paper."

By Mr. A. Morton, F.L.S.

13. "Notes on a recent dredging trip in the Derwent."
14. "What Science and Commerce may gain from an Antarctic Expedition."
15. "A complete list of Ferns found in Tasmania, with full descriptions of the genera and species."

By Mr. A. J. Taylor.

16. "On the coco-de-mer *(Lodoicea seychellarum).*"
17. "Notes on the Native Hop *(Daviesa latifolia)* as a cure for Hydatids."

By Wm. Montgomery, M.A., Government Geologist.

18. "Notes of some geological observations on the West Coast."

By Mr. A. T. Urquhart, Corresponding Member.

19. "Description of some new Tasmanian Spiders."

By Mr. James Andrew.

20. "Notes on Ostrich Farming."

By Mr. A. J. Ogilvy.

21. "Can the toiling masses really improve their condition by these incessant and unhappy Strikes, or are they only beating their hands against the iron bars of inexorable economic law ?"

By C. E. Barnard, M.D.

22. "Actinomycosis and Tuberculosis."

By Baron Mueller.

23. "Notes on a new Tasmanian plant of the order Burmanniaceæ."

It will thus appear that original work of a valuable character, especially in reference to the Natural History of Tasmania, has been done during the session ; and it is satisfactory to report that the annual volume will very soon be ready for distribution.

COUNCIL.

No change has taken place during the session.

LIBRARY.

The most noteworthy circumstance in connection with the Library has been the very liberal donation by His Excellency of the recent (9th) edition of the "Encyclopedia Britannica," 24 vols. Dr. Agnew also presented the Report of the scientific results of the voyage of H.M.S. *Challenger* during the years 1873–6, in three volumes.

FELLOWS.

Seventeen Fellows and two Corresponding Members have been elected ; nine have resigned.

FINANCE.

The income has been—Subscriptions to Royal Society, £189 ; fixed deposit, £323 8*s.* 9*d.*; interest, £5 15*s.* ; total, £518 3*s.* 9*d.* Expenditure, £244 2*s.* 9*d.*

STATEMENT of the Funds of the ROYAL SOCIETY *for the Year* 1890.

Receipts.	£	s.	d.
Fixed Deposits	323	8	9
Subscriptions	189	0	0
Fixed Deposit (Interest)	5	15	0
	£518	3	9

Expenditure.				£	s.	d.
Balance				37	9	0
Salary of Secretary				50	0	0
Ditto Attendant				6	0	0
Petty Cash				1	4	3
Printing, Stationery, and Periodicals				151	19	6
Interest due to Museum				15	8	9
Insurance				1	5	0
Cheque Book				0	8	4
Collector's Commission				7	10	0
Gas and Fuel				9	4	11
Legal Expenses				1	2	0
Balance per Bank Book	£29	13	0			
Cheque paid into Bank 14th Jan., 1889	1	1	0			
				28	12	0
Fixed Deposit				208	0	0
				£518	3	9

Examined and found correct.

JOHN MACFARLANE.
FRANCIS BUTLER.

11*th March*, 1891.

STATEMENT of the Funds of the MORTON ALLPORT MEMORIAL FUND *for the Year* 1890.

1890. Dr.	£	s.	d.	Cr.	£	s.	d.
Balance as per statement for 1890	50	5	9	Balance in Savings Bank to credit of Fund	68	1	4
Interest..	17	15	7				
	£68	1	4		£68	1	4

Examined with Savings Bank Book, and found to be correct.

JOHN MACFARLANE.
FRANCIS BUTLER.

11*th March*, 1891.

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.

PAPERS AND PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

TASMANIA,

FOR

1891.

TASMANIA:
PRINTED AT "THE MERCURY" OFFICE, MACQUARIE ST., HOBART.

1892.

The Responsibility of the Statements and Opinions given in the following Papers and Discussions rests with the individual Authors; the Society as a body merely places them on record.

ROYAL SOCIETY OF TASMANIA.

Patron:
HER MAJESTY THE QUEEN.

President:
HIS EXCELLENCY SIR ROBERT GEORGE CROOKSHANK HAMILTON, K.C.B.

Vice-Presidents;
HON. J. W. AGNEW, M.D., M.E.C.
JAMES BARNARD, ESQ.
HIS HONOR SIR WILLIAM LAMBERT DOBSON, KNT., C.J., M.E.C., F.L.S.
THOMAS STEPHENS, ESQ., M.A., F.G.S.

Council:
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* HIS HONOR SIR WILLIAM LAMBERT DOBSON, KNT., C.J., M.E.C., F.L.S.
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Hon. Secretary:
HON. J. W. AGNEW, M.D., M.E.C.

Auditor of Monthly Accounts:
C. T. BELSTEAD, ESQ.

Auditors of Annual Accounts:
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Secretary and Librarian:
ALEXANDER MORTON, ESQ., F.L.S.

* Members who next retire in rotation.

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ROYAL SOCIETY.

APRIL.

The first monthly meeting of the session of 1891 was held on Tuesday evening, April 21. The President His Excellency Sir R. G. C. Hamilton, K.C.B., presided, and there was a good attendance of Fellows. Lady Hamilton and a number of ladies were also present.

CORRESPONDING MEMBER.

Rev. F. R. M. Wilson, Kew, Victoria, was elected a corresponding member.

ANTARCTIC EXPEDITION.

Mr. Morton stated that he had received a list from the hon. secretary of subscriptions in aid of the Antarctic expedition, showing that the following sums had been subscribed:—Royal Geographical Society of Australasia (Victorian Branch), £200; Mr. J. S. Gotch, of Messrs. Gordon and Gotch, £100; Professor Kernot, £100; E. C. Merewether (President N.S.W. Branch of Royal Geographical Society of Australasia), £100; Royal Society of Tasmania, £50; Royal Society of Victoria, £100; Dr. Agnew, £100. He (the Secretary) had placed Dr. Agnew's name on the list as having subscribed from Tasmania.

His Excellency said that a few days ago he had received a cablegram from Baron Von Mueller, stating that New South Wales had placed £2,000 and Queensland £1,000 on their annual estimates in aid of the proposed Antarctic exploration. He asked whether the Tasmanian Government would place £500 on the estimates for the same purpose. He had handed the cablegram to Ministers, but had not as yet received any answer.

GIFT FROM DR. AGNEW.

The Secretary said that the Society was indebted to Dr. Agnew for another munificent gift. Some years ago back the Society obtained 12 parts of the Birds of Asia, by J. Gould, F.R.S., a rare and expensive work. The complete work consisted of 35 parts and Dr. Agnew had instructed him (Mr. Morton) to complete the set, which he had done through Trübner and Co., of London, at a cost of £75.

His Excellency referred in appreciative terms to the interest Dr. Agnew had shown in the Society, and the practical effect he had given to that interest by many valuable presents. He asked them to join with him in carrying by acclamation a hearty vote of thanks to Dr. Agnew. (Applause.)

AUSTRALASIAN SCIENTIFIC ASSOCIATION.

Mr. Morton said—Your Excellency and members of the Council of the Royal Society of Tasmania; having been appointed in conjunction with Mr. C. H. Grant as a delegate of the Royal Society of Tasmania to the meeting of the Australasian Association for the Advancement of Science, held at Christchurch, New Zealand, during the week commencing January 15, 1891, it becomes my duty, in the absence of Mr. Grant, who is out of the colony, to report to you on matters relating to the meeting. At the first general committee meeting, held at the Canterbury College, January, 15, Sir James Hector, K.C.M.G., President-elect for 1891, proposed that His Excellency Sir R. G. C. Hamilton, K.C.B., be the President for the fourth meeting, to be held at Hobart in 1892; a motion that was enthusiastically received and unanimously adopted. The other officers then elected for the Tasmanian meeting were Mr. James Backhouse Walker as local treasurer, and your delegate as general secretary. The New Zealand meeting, which lasted seven days, was a great success. The sections one and all were largely attended, and the deepest interest was taken in the many valuable papers read. The members attending the New Zealand meeting were most hospitably entertained by the Christchurch residents. The thanks of the association are largely due to Professor F. W. Hutton, F.G.S., the general secretary, for the New Zealand meeting, for the great attention paid by him to all members attending the meeting. As soon as possible after my return the Tasmanian Local Executive Committee, consisting of the Hon. J. W. Agnew, M.D., Messrs. James Barnard, C. H. Grant, R. M. Johnston, J. B. Walker, and myself, had a meeting with the object of taking the necessary steps to appoint Presidents, Vice-Presidents, and Secretaries to the different sections and to arrange other matters for the fourth meeting. The committee decided that the 1892 meeting shall commence on Thursday, January 7, 1892. The rules are that presidents of the various sections must reside out of the colony in which the meeting is held; vice-presidents and secretaries are to be residents of the colony. It is gratifying to know that the presidents in nine sections out of ten are already appointed:—Section A, Astronomy, Mathematics, Physics, and Mechanics, Professor W. H. Bragg, M.A., Professor of Mathematics, University of Adelaide. Section B, Chemistry and Mineralogy, Mr. W. M. Hamlet, F.C.S., F.I.C., Government Analyst of New South Wales. Section C, Geology and Palæontology, Mr. C. S. Wilkinson, F.G.S., Government Geologist of New South Wales. Section D, Biology, Professor W. Baldwin Spencer, M.A., Professor of Biology, Melbourne University. Section F. Economic Social Science and Statistics, Mr. R. Teece, F.I.A., of Sydney. Section G, Anthropology, Rev. Lorimer Fison, Queen's College, University, Melbourne. Section H, Sanitary Science and Hygiene, Professor W. H. Warren, M.I.C.E., Professor of Engineering, University of Sydney. Section I, Literature and Fine Arts, E. E. Morris, Professor of English, German, French languages, and Literatures, Melbourne University. Section J., Architecture and Engineering, Mr. C. Napier Bell, C.E of New Zealand. Section E. is therefore the only section without a president, but His Excellency Sir William Macgregor, Governor of New Guinea, has been asked to accept the presidency of this section, and his reply is daily expected. Satisfactory arrangements have been made with all the Australian railway authorities and steamship companies for members travelling to attend the meeting. The Railway Commissioners will allow all members to travel at single fare for double journeys, and the steamship companies 20 per cent. off ordinary excursion rates. The Tasmanian Government and the Mount Bischoff Railway Co. have agreed to grant similar concessions to those granted on the New Zealand railways, viz., members to be allowed to travel half single fares during the months of January and February. The Municipal Council have generously placed the large room, and as many other rooms as can be spared, of the Town Hall buildings at the disposal of the association, and the Chamber of Commerce have consented to do likewise with their room. A large gathering from all the colonies is expected, and numerous promises of papers in different sections have already been received. From the outlook at present the fourth meeting of the Australasian Association bids fair to be the most successful yet held.

His Excellency said that when asked to become President of the Australasian Association for the Advancement of Science he at first refused, because he thought the position was one which ought to be held by someone who was distinguished in some branch of science. The matter, however, was again pressed upon him, and he was told from several quarters that it was desirable from many points of view that he take the position. It was a position which anyone might be proud to hold, and his hesitation in accepting it only arose from his thinking he could hardly be able to do justice to its duties. When he found, however, that it was the desire of the association that he should become President, he at once accepted, and having accepted, he meant to do everything in his power to make the meeting a great success. The first thing he did was to try to secure the presence of Professor Huxley, who some time ago contemplated visiting Australia. He wrote to Professor Huxley and had received a reply, in which the Professor said that he had very pleasant recollections of Tasmania 43 years ago, and it would interest him very much to re-visit the colony and compare the present with the past, but he regretted that the state of his health prevented him from accepting the invitation. He (President) was sure that they all regretted that Professor Huxley was unable to come, and that ill-health was the cause. Mr. Morton, in his report, had given a most satisfactory list of the Presidents and Vice-Presidents, and had mentioned the name of Sir Wm. McGregor as one who had not yet signified his intention to be present. He had written to Sir William, and pointed out to him the importance of the meeting. He had invited Sir William to be his guest at Government House, and he hoped he would come and lend that *eclat* which his great reputation and the great work he had done in New Guinea would bring to the meetings of the association. He had also written to two gentlemen in England, distinguished in the walks of science, asking them to come out to Tasmania and be his guests on the occasion of the meetings of the association. He hoped that both, or at least one, of these gentlemen would accept his invitation, and he had no doubt but that in the event of his being successful in announcing the names of those gentlemen as visitors to Tasmania, they would be received with the greatest satisfaction by the members of the association. He was glad to see so many present in this, the first meeting of the present session of the Royal Society, including their friend, Mr. Alfred J. Taylor, who had just recovered from a serious illness.

The **Right Rev. H. H. Montgomery, D.D., Bishop of Tasmania**, read a paper entitled "Some account of the Mutton Birds, or Sooty Petrels *(Nectris Brevicaudus)*, as seen in their Homes among the Furneaux Islands, Bass Straits, Tasmania, from Notes taken during a visit to the Locality in March, 1891."

Mr. **T. Stephens** called attention to some specimens on the table :—1. A specimen of shale from near the Henty River, with *Glossopteris*, etc., and closely resembling the shale in which more than twenty years before he found the first impression of this fern in the Mersey coal measures. Like the Mersey coal, this shale occurs under marine fossiliferous beds of carboniferous age. 2. Pieces of coal from the flanks of Mount Manfred, north-west of Lake St. Clair, cropping out at a height of about 3,000ft. above sea level. 3. Silurian limestone from the site of a bore recently put down at Railton in search of coal, with a portion of core belonging to the same series from a reported depth of about 600ft. Mr. Stephens remarked that the lavish expenditure which had been incurred here in boring through strata, which are well known by all acquainted with the geology of the district as being, geologically speaking, below the whole of the Mersey coal measures, was a startling instance of that enterprise of which Tasmania was supposed to be destitute. It was a pity that it was not more wisely directed.

The SECRETARY, in the absence of the author, read a paper, entitled "Notes on Mount Lyell District, Tasmania," by Mr. F. Danvers Power, F.G.S.

Mr. R. M. JOHNSTON replied briefly, when it was decided to postpone discussion until next meeting.

HIS EXCELLENCY proposed the usual votes of thanks to the contributors of papers, which having been carried by acclamation, the meeting adjourned.

MAY.

The monthly meeting of this Society was held on May 13, the President His Excellency Sir R. G. C. Hamilton K.C.B., in the chair. There was a good attendance of Fellows, and also a number of lady visitors.

THE ANTARCTIC EXPEDITION.

The **Secretary** read a telegram from Baron Von Mueller, suggesting a deputation from the Society to the Government in aid of the fund now being raised for the proposed Antarctic Expedition.

Mr. James **Barnard** said that he was rather in favour of viewing this as an Australasian and Imperial question, and that the expense generally should be shared between Australia and the Imperial Government. It seemed, however, that there was no hope of that being obtained, and, therefore, he moved—"That it be a recommendation from the Society to the Council to wait on the Premier to see if the Government would be disposed to assist in this matter."

Sir **Lambert Dobson** seconded.

The **President** said that the position of the matter was this. He received a telegram from Baron Von Mueller, which he read at last meeting, to the effect that New South Wales had put £2,000 on its estimates, and Queensland £1,000, and asking whether Tasmania would contribute £500. He had referred the telegram to Ministers, but had not heard from them. He took some blame to himself in the matter, because he had not applied to Ministers, but now that it had been proposed and seconded that a deputation wait on the Premier he thought that would be the best way to proceed.

The motion was agreed to.

CONGRATULATORY.

Mr. **Morton**, as secretary, called attention to the fact that two members of the Society, Mr. James Barnard and Hon. Dr. Agnew, celebrated this month their jubilee as members of the Society. In 1841 both of these gentlemen were admitted as members, Mr. Barnard having been admitted on the motion of Mr. Bedford, seconded by Sir John Franklin. At that meeting there were present Rev. Dr. Lillie, and Captains Ross and Crozier, who had just returned from a cruise to the Antarctic Ocean. He believed that this Society, one of the oldest in Australia, was the only one that could boast of having two members who had been so long in membership, and still able to take their part as active working members. He saw from the records that Mr. Barnard had been very seldom absent from the meeting of the Society or of the Council. The only time there was a lapse in attendance was during Mr. Barnard's visit to England. He thought it his duty as secretary to bring those interesting facts under notice, and he placed before the Society the original manuscript of the election of Mr. Barnard, with the signature of Mr. Henslow, who was then private secretary to Sir John Franlkin, and acted as honorary secretary to the Royal Society.

Sir **Lambert Dobson** expressed pleasure at hearing the interesting facts just stated, and said that all joined in congratulating Mr. Barnard and Dr. Agnew, and in wishing that they might yet be spared many years to take an active part in the work of the Society.

Mr. Barnard said he was quite taken by surprise by this recognition of his membership, and regretted that Dr. Agnew was not present on the occasion. He felt honoured by the reference made to himself. He had a feeling of shortcoming in that he had not throughout the long period referred to done more for the Society than he had done. Of course it should be remembered that during forty years he had the conduct of a very onerous department in the Government service, and had very little leisure to devote to scientific matters. He felt thankful for having been spared till this time and able to look back during all that vista of years. He remembered that the first paper read before the Society was an admirable one by the Rev. Dr. Lillie, and that Rev. Mr. Ewing prepared the first catalogue of Tasmanian birds, a work which has since been taken up and expanded very considerably by modern contributions from members of the Society. He did not, however, think he should inflict a speech upon them on the occasion, but would only again express his great appreciation of the feelings that prompted this reference to himself.

APPLE SCAB.

Mr. A. Morton drew attention to a fungus affecting the apple. During the last few weeks several apples had been sent him. On examination he found they were attacked by a fungus, and on submitting them to Dr. N. A. Cobb, of the Department of Agriculture of Sydney, he reported that the fungus was the ordinary apple scab, *Fusicladium dendriticum*, and that it might be almost prevented, at a slight cost, by spraying the trees once in every two or three weeks during the spring and summer with the mixture known as "Ammonio-carbonate of copper." Dissolve 2lb. of copper sulphate (bluestone) in hot water. Dissolve 2½lb. sodium carbonate in another vessel of water. Mix the two together, and before using add 1½ pints of ammonia, and then dilute to 30 gallons with water.

The Secretary read the following correspondence :—

151, Macquarie-street, May 12th, 1891.

"Dear Mr. Morton,—I regret I shall be unable to be at the Royal Society's meeting to-night. Would you mind recording the existence in Tasmania of the two following plants :—

Lobelia rhombifolia, found in October, 1890, on the road from St. Helens to Constable Creek by Wm. Fitzgerald. The plant was sent to me, and I forwarded it to Baron Von Mueller, and I enclose his reply. Unfortunately I have no specimens.

Orthoceras strictum, found in December, 1890, by Mr. Geo. Hinsby near George's Bay. I recognised the plant as *O. strictum*, and when Baron Von Müeller was here he confirmed it I leave the dried specimen for your examination.

Kindly let me have the letter and specimen again, as I have to return the former, and wish to keep the latter.

Yours faithfully,
L. Rodway."

"Let me congratulate you, dear Mr. Fitzgerald, for your discovery of a plant, new as regards the records of the Tasmanian flora. It is the *Lobelia rhombifolia* of De Viese, originally found by Drummond in West Australia; in 1848 traced by me into South Australia, and since then found in some few places of Victoria. The Tasmanian locality will be recorded in my work under your honoured name. Where this plant occurs perhaps you may find other rare plants yet. As you seem to take an interest in the indigenous plants of your beautiful island I would particularly remark that the floating and submerged plants there require still more attention there than any others, even as far as the small water lentils. It would be well in each instance if the specimens were pressed and dried before they are sent off, as otherwise they suffer in transit. May I advise you to send to Mr. Alex. Morton, Secretary of the Royal Society of Tasmania, a note regarding the discovery of the Lobelia in your Island, and to dry specimens for being submitted to the next meeting in Hobart.

Regardfully yours,

FERD. VON MUELLER."

CALCULATING MACHINE.

Mr. R. M. JOHNSTON gave a lucid and practical demonstration of the method of working a new calculating machine introduced into the Statistician's Department to facilitate the work of that department in calculations. The machine is called the "Arithmometer." In the absence of the author Mr. Johnston read a paper, prepared by Mr. F. Jacobs, A.I.A., entitled "Notes on the Arithmometer as an aid to actuarial work."

The Secretary, in the absence of Mr. A. B. Biggs, read a paper prepared by that gentleman entitled "The Possibilities of the Telescope."

Mr. A. Montgomery, M.A., Government Geologist; Mr. W. F. Ward, Government Analyst, and Mr. T. Stephens, M.A., and Mr. R. M. Johnston, replied at some length to the paper of Mr. Powers, read at the last meeting, entitled "Notes on the Mt. Lyell District, Tasmania.

On the motion of His EXCELLENCY, the customary vote of thanks was passed to those who had contributed papers and remarks, and the proceedings terminated.

JUNE.

The monthly meeting of this Society was held on June 9, the President, His Excellency Sir R. G. C. Hamilton, K.C.B, presiding.

PAPERS AND PROCEEDINGS.

The SECRETARY laid on the table the published papers and proceedings of the Society for the year 1890.

ANTARCTIC EXPEDITION.

His EXCELLENCY said that at the last meeting of the Royal Society a resolution was passed asking the Council to wait on Ministers to ascertain whether they would be prepared to recommend Parliament to vote a certain sum towards the expenses of the Antarctic expedition under Baron Nordenskiold. Before, however, any action was taken by the Council, an intimation was received from Ministers that they had determined to ask Parliament for £300 towards the proposed expedition. He telegraphed that fact to Baron Von Mueller, and received the following telegram in reply :—"Grateful for support Tasmanian Government to Nordenskiold expedition. This greatly strengthens the whole cause." He did not know how far the matter had progressed since, but thought it satisfactory that in Tasmania everything had been done that could be expected in this matter.

AUSTRALASIAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE.

His EXCELLENCY thought it desirable that a progress report should be made by Mr. Morton in reference to the arrangements for the approaching meeting of the Australasian Association for the Advancement of Science.

Mr. MORTON said that he had sent out 950 circulars to members of the Association and others throughout Australia requesting them to notify whether they intended to be present, although he had not received one quarter of the replies expected, already 150 had notified their intention of being present at the meeting to be held in Hobart on January 7 next. Papers had been promised by able contributors in the following sections :—Astronomy, chemistry, geology, biology, geography, economic and social science, anthropology, literature, and fine arts. He regretted to intimate that Sir Wm. McGregor, Governor of British New Guinea, had written stating that it was impossible for him to leave his work there early next year in order to attend and occupy the position of president of the geographical section. Mr. Morton further stated that liberal concessions in the matter of travelling rates had been granted to members, and he had no doubt that the result would be a large influx of visitors. At the meetings of the Association in New Zealand last year, large numbers of local residents became members of the Association, and he hoped a similar result would take place here, as by becoming members they would have the privilege of attending the different sections.

His EXCELLENCY said : I think we may be satisfied with the progress made as detailed by Mr. Morton. I may say that I also had a letter from Sir William McGregor similar to that received by Mr. Morton, but I thought the matter of so great importance, that I wrote to him again. I am sure it will be very agreeable to this Society to learn that I have succeeded in getting Mr. Giffen, the eminent statistician and political economist, to agree to pay me a visit during the session of the Australasian Association for the Advancement of Science to be held here in January next, and to read a paper before the Association. Mr. Giffen, as many of you know, is one of the highest living authorities on economic science, and I am sure that his presence on this occasion will be greatly appreciated by the members of the Association, and that it will give an impetus to the study of this science, which will bear fruit throughout all the Australasian colonies. (Applause.)

The SECRETARY apologised for the absence of Mr. R. M. Johnston, owing to indisposition, and read the following remarks, prepared by that gentleman in connection with this subject:—It is pleasing to observe with what enthusiasm His Excellency Sir Robert Hamilton, the president-elect of the Australasian Association for the Advancement of Science, is endeavouring to make this, the fourth meeting, taking place in Hobart in January next, one of the most successful of the series yet held. The Association, mainly owing to the instrumentality of its present permanent general secretary, Prof. Liversidge, was founded in the year 1886, and has since held three very successful meetings; the first in Sydney, in January, 1888; the second in Melbourne, in January, 1890; the third in Christchurch, New Zealand, in January of the present year. The Association follows exactly the lines of the British Association, and like that Association its objects are—To give a stronger impulse and a more systematic direction to scientific enquiry; to promote the intercourse of those who cultivate science in different parts of the Australasian colonies with one another and with foreign philosophers; to obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which may impede its progress. Science in Australasia has already received a great impulse from these yearly gatherings, the direct and indirect results of which will have a most important bearing upon the intellectual, social, and material progress of these colonies. It is evident from what has been disclosed at the last meeting of the Royal Society that His Excellency Sir Robert Hamilton does not intend that one of the express objects of the Association should remain a barren phrase, viz.:—"To promote the intercourse of those who cultivate cience in different parts of the Australasian colonies with one another and with foreign philosophers." Already he has, through the energetic General Secretary (Mr. A. Morton, F.L.S.), received the assurance that at its next meeting in Hobart will be assembled one of the largest gatherings of scientific men of Australasia which has yet been brought together, including nearly all the most prominent names in various branches of science, art, and philosophy; and he has also endeavoured to throw additional lustre upon this gathering by cordially inviting as his guests for the occasion several of the most illustrious men of science in the Mother Country. One of these, Professor Huxley, has written a most cordial letter regretting that the state of his health alone prevents him from accepting His Excellency's hospitality and denying himself the pleasure it would afford him to re-visit Tasmania, of which he has still many pleasant recollections. It is gratifying, however, to know that he has received the assurance that Dr. Giffen, LL.D., now created a C.B., one of the most illustrious economists and statisticians of Europe, is to become his guest, and will be present to take part in the work of the Association. In economic science the name of Dr. Robert Giffen stands in the very first rank of the most illustrious names in Europe, and there is no authority in Europe who at the present moment is held in greater respect, and whose writings exert a deeper and wider influence on the great political and social economic problems which at present disturb the industrial relations of nearly all civilised countries.

Of the many distinguished Presidents of the Royal Statistical Society of England it is certain that he ranks among the foremost, while his numerous contributions to the journal of that Society, in connection with important questions of the day, reveal what a marvellously wide and thorough grasp he possesses of the facts which bear upon the subjects which he discusses, and of the still more remarkable power displayed by him in the manner in which he brings his facts into logical array, and in drawing important conclusions therefrom. Perhaps in this respect he has no living equal in his own branch of science. The following is a list of the more important papers on statistical and economic subjects contributed by Dr. Giffen to the Royal Statistical Society since the year 1879:—(1) "On the fall in prices in recent years."—(Journ. S.S., Mar. 1879). (2) "The progress of the working classes in the last half century (presidential address).—(Journ. S.S., Dec. 1883.) (3) "Further Notes on the progress of the working classes in the last half century."—(Journ. S.S., Mar. 1886). (4) "Recent rate of material progress in England" (presidential address, Brit. Assoc. 1887).—(Journ. S.S., Dec. 1887). (5) "Recent changes in prices and incomes compared."—(Journ. S.S., Dec. 1888.) (6) "Accumulation of capital in the United Kingdom in 1875-85."—(Journ. S.S., Mar. 1890). Dr. Giffen's presidential address to the Royal Statistical Society in 1883, "The progress of the working classes in the last half-century" was a most remarkable one, and created a profound impression throughout Europe, America, and these colonies, and the effect on the minds of the leading statesmen of the United Kingdom is best indicated by the fact that at Mr. Gladstone's special request the address was reprinted, and widely circulated throughout the United Kingdom. Dr. Giffen is also widely known as the author of several important works on financial matters. The presence of such an illustrious economist will add great lustre to the coming meeting of the Association, and will be especially welcomed by Section F.—Economic and Social Science and Statistics—where his active support and influence will undoubtedly increase the interest and usefulness of its proceedings.

SOUTHPORT CAVES.

His EXCELLENCY said that there had recently appeared in the Press an account of some caves recently discovered at Southport. Mr. Morton formed one of the party who visited the caves, and brought away some specimens, and he thought it would be interesting to hear from him an account of that visit.

Mr. MORTON said that an opportunity having been afforded to visit the caves in the vicinity of Ida Bay, near Southport, he took advantage of it, and notwithstanding the short time at his disposal he thought that what he saw was sufficient to justify writing to the Minister of Lands, drawing his attention to the very urgent necessity of having these caves thoroughly examined and a report furnished, with a view of having them protected, under similar conditions to the well-known Jenolan and Fish River Caves in New South Wales. As these caves were of easy access from Hobart, excursionists being able to reach them within five or six hours, they should undoubtedly prove a favourite resort to tourists and visitors to the colony. They were situated about four miles from Ida Bay, and a fairly good road led to them. On reaching the mouth of the caves it was seen that the entrance was through a limestone formation. There was a very strong stream flowing along the floor of the cave. The first chamber reached showed some fine stalactites, and along the floor some fine stalagmites were seen. On extinguishing the lights carried by the party the ceiling and sides of the caves seemed studded with diamonds, millions of glow-worms hanging to the sides of the walls and from the ceilings causing this phenomenon. Proceeding further, several chambers were explored, each revealing grander sights. The time at disposal being limited, the party had to return after traversing a distance of about three-quarters of a mile, but from what was observed the caves evidently extended a distance of three or four miles. The only life met with in the caves were the glow worms previously mentioned. These caves, under proper supervision, should become one of the great attractions of the South.

Mr. **Bernard Shaw** concurred in the recommendation made by Mr. Morton, and hoped it would be adopted by the Minister of Lands. He thought that there would be very little trouble in having those caves protected, as there was a station with resident police at Southport.

NEW ZEALAND EXHIBITS.

Mr. **Morton**, as Curator of the Museum, drew attention to specimens of greenstone from New Zealand, also of axes and knives used by the Maoris, the latter being made out of obsidian, the gift of Messrs. A. Hamilton and F. R. Chapman, of Dunedin, New Zealand, to the Tasmanian Museum.

The Secretary read, in the absence of the author, the following papers:—1. "Results of observations of the transit of Mercury on May 10, 1891." 2. "The total eclipse of the moon on May 24, 1891." By A. B. Biggs.

JULY.

No meeting held.

AUGUST.

The monthly meeting of this Society was held on Monday evening, August 17. The President, His Excellency Sir R. G. C. Hamilton, K.C.B., presided, there was a large attendance of Fellows, also a number of ladies.

NEW MEMBERS.

Dr. O. Burchard, of Hamburg, was elected a corresponding member, and the following to be members:—Walter Spencer, M.D., Launceston; W. F. M. Shells, M.R.C.S.E.; George Henry Gibson, M.B. and C.M., Edinburgh; Wm. Earle, Mount Zeehan; Ernest Milton Law, and Wm. Dubrelle Weston.

MACQUARIE ISLAND.

The Secretary read the following letter from Captain Fairchild, of the New Zealand Government steamer Hinemoa.—" Wellington, June 3, 1891:—I see your Government has prohibited sealing on the Macquarie Island. It is a wise step, because if it had gone on a few years longer there would not have been a seal or a sea elephant left on the island. I think the penguins (the king penguin *Aptenodytes longirostris*) should be protected for, say, five years on Macquarie Island, or else they will soon be all gone—that beautiful bird is only found on the Macquarie Island. There are none on any of the islands belonging to New Zealand, and as they are such a helpless bird and so easily caught, there will not be one left in five years if they go on killing as they have the last year or two. So I hope soon to hear that the king penguin are not allowed to be killed on Macquarie Island for the sake of their oil. The man on the island told me he killed 15,000 last year for their oil, from which he got 15 tuns of oil."

Sir LAMBERT DOBSON suggested that as the subject was a new one it should be considered by the Council and afterwards by the Society, so that it could go before the Government after mature consideration. He moved,—" That the letter be referred to the Council of the Society," which was agreed to.

SCIENTIFIC INFORMATION.

In the absence of the author, Mr. A. J. Ogilvy (the SECRETARY) Mr. Morton read an abstract of the paper prepared by that gentleman, entitled " Suggestions as to the best means for collecting scientific information." The writer suggested that the Royal Society should obtain the services of some resident in each district of the colony, if possible, to act as its hon. representative in that district. He should commence as soon as he conveniently could to collect specimens illustrating the geological features and useful products of his district as, generally, of the granite or other chief rocks, especially of the coal, limestone, fireclay, or other useful products, for comparison with similar specimens from other districts. Also any striking examples of petrifaction, crystallisation, etc., in short anything likely to be of scientific interest. On hearing of any interesting discovery in his district, he would put himself in communication with the discoverer and report to the Society. He would be the recognised agent of the Society in the district to whom discoverers and inquirers would voluntarily apply to give or receive information; to whom also the Society could refer for any special local information it might require. Such an appointment would not only serve many direct practical ends but would also arouse increased interest among these co-operators in scientific subjects and in the affairs of the Society; would stimulate them to closer attention to their surroundings, and would help to propagate an interest in scientific progress throughout the colony.

AUSTRALASIAN SCIENTIFIC ASSOCIATION.

His **Excellency** asked if there was any progress report *re* the meeting of the Australasian Scientific Association for the Advancement of Science in January next.

Mr. **Morton** said that so far everything was progressing very favourably. Some 200 members had already signified their intention of being present, and a number of papers had been promised. He had also pleasure in intimating that ladies would be admitted to the meetings and have the privilege of taking part in the discussions and reading papers on payment of a small fee.

PAPERS.

TASMANIAN INSECTS.

The **Secretary** read an interesting extract from a letter written by Mr. J. J. Walker, R.N., Chief Engineer of H.M.S. Penguin, in which he stated that the collection of insects made by him during his visit to Hobart had turned out well. He had sent to the British Museum 1,122 mounted specimens. They consisted of 586 species of coleoptera from Hobart, and 1,871 specimens of 798 species from all Tasmania, being perhaps one-fourth of the varieties of insects in the island.

HYPNOTISM AND ALLIED PHENOMENA.

Dr. **Walter Spencer**, Launceston, read a paper on the above subject. The paper was a lengthy and elaborate one, and in it Dr. Spencer dealt with the established facts in regard to Hypnotism, and described the sensation which it caused among members of the medical profession when introduced as a means of painless operations. Although its use in the alleviation of pain among the medical profession in England gave place to chloroform and ether it was taken up in France where two different schools prosecuted its study. He gave illustrations of the rival methods employed by practitioners of this new power, and pointed out the dangers of its practice, which caused the British Medical Association to pass a special resolution on the subject. He described how he had practically studied the subject in London 15 years ago, and at the end of a series of 12 lessons was able to relieve small pains by its use. He showed the identity of hypnotism with mesmerism, and gave a most interesting account of the history of such phenomena illustrated by numerous examples. A discussion followed, in course of which Messrs. A. J. Taylor, R. M. Johnston, Justice Adams, and Sir Lambert Dobson took part, after which a vote of thanks was awarded to Dr. Spencer.

His Excellency retired to fulfil another engagement, and His Honor Sir Lambert Dobson took the chair.

TASMANIAN PLANTS.

The **Secretary** read some brief remarks by Baron von Müeller. bringing under notice some rare Tasmanian plants lately found by Mr. T. B. Moore on the highlands east of Mount Tyndall. Baron Müeller considered the plants to be a new species of *Coprosma*, its characteristics being a very depressed, matted growth, very small leaves, and terminal small-sized fruit. The leaves were pointed, and the fruit beautifully blue outside. He recommended that if the plant proved a peculiar species it be distinguished under the finder's name.

Baron Müeller also acknowledged indebtedness to Mr. Moore for providing him with specimens of the *Panax Gunnii*, a rare shrub, found in deep shady gorges at Mount Lyell on the Canyon River, the Franklin River, and on a tributary of the Pieman River. From the highlands of Mount Read and Mount Tyndall, Mr. Moore sent specimens of the *Pentachondra verticillata*, a species of *Styphelia*, which until now was only known from Dr. Milligan's collection.

MOUNT LYELL.

The SECRETARY, in the absence of the author, read notes on the Mount Lyell district by Mr. F. Danvers-Power, F.G.S., being a rejoinder to criticisms by members of the Society on the paper recently written by him on that subject. The writer expressed surprise that his critics credited him with being the author of new theories. It was possible that he was the first to apply the views expressed in his paper to Tasmanian geology, but he did not pretend to be the originator of what Mr. Stephens termed the "water pressure and wave theory," or of the anti-true-fissure-lode theory, although he was prepared to uphold them until disproved, or more suitable substitutes were brought forward, His paper was intended to give but a sketch of the geology of the Mount Lyell district. He was aware from Tasmanian literature, as also by personal conversation, that his views were in opposition to those generally accepted in the island, but by bringing the results of modern research to bear on local conditions, he had hoped to direct thought out of the groove into which it had fallen. Of course he did not expect to win those who had strong views on the subject over to his side at once, but he did expect them either to give valid arguments for their side of the question, or to prove his incorrect, especially when those sentiments were due to misconceptions on their part. He then dealt at length with the points on which his critics differed from him—(1) the main cause of mountain ranges; (2) the nature of most so-called true fissure lodes.

Discussion on Mr. Power's paper was postponed to a future meeting.

This concluded the meeting.

LIST OF ADDITIONS TO THE LIBRARY.

Aborigines of Australia. A paper read before the American Antiquarian Society, Boston, April 30, 1890, by E. E. Porter, M.A. From the author.

Abhandlungen der Mathematisch Physikalischen Classe der Koniglich Bayerischen Akademie de Wissenschaften, Munich, 1889. From the Academy.

Agricultural Gazette of New South Wales (current numbers), 1891. From the Department.

American Agriculturist, 1891 (current parts).

Annales de la Société Entomologique de Belgique. Tome XXXII., 1888; Tome XXIV., 1889. Bruxelles, 1890. From the Society.

Annals and Magazines of Natural History, 1881 (current parts).

Annual report of the Curator of the Museum of American Archæology in connection with the University of Pennsylvania, 1890. From the Department.

Anzliger der Kaiserlichen, Akademie der Wessenschaften, Wien. From the Society.

Annales de la Société Royal Malacologique de Belgique. Tome XXIV. From the Society.

Archives du Musée Teyler, Sèrie II., Vol. III., 4. From the Society.

Astronomische arbeiten, Wien, 1890. From the Department.

Atti della Reale Accademia dei Lincei, Rome (current numbers, 1891.) From the Academy.

Boletin del Institute Geografico Argentine, Tomo XI., Cuadernos IV. to IX., Bueno Aires, 1890. From the Institute.

Boletin Mensual del Observatorio Meteorologico del Colegio, Pio de villa colon, Monte Video. From the Department.

Boletin Sociedade de Geographia de Lisboa (current numbers), 1891. From the Society.

Bollettin della Societia Geograpica Italiana (current numbers), 1891. From the Society.

Bollettino Musei di Zoologia ed Anatunia Comparata della R, Universita di Tornio. From the Department.

Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. XX., No. 8. The parietal eye in some Lizards from the Western United States, by W. E. Ritter (Plates), Vol. XXI., No. 1. Contributions to the Morphology of the Turbellaria. I. On the structure of Phagocata gracilis, by N. M. Woodworth, Vol. XX., No. 3 to 7. Annual Report of the Curator for 1889-90. From Alexander Agassiz.

Bulletin of the Essex Institute (current numbers.) Charter of by-laws of the institute. Mass. 1890. From the Institute.

Bulletin of the Agricultural Experiment Station of Nebraska, Vol. IV., Sugar-beet Series, No. 2; also Fourth Annual Report. From the Department.

Bulletin Department of Agriculture, Brisbane (current numbers), 1891. From the Department.

Bulletin de la Societe Imperiale des Naturalistes de Moscow (current numbers). From the Society.

Bulletin of the American Museum of Natural History, December 1889. Vol. II., No. 3; Vol. III., No. 1, No. 4. New York, 1890. From the Trustees.

Bulletin of the United States National Museum, No. 38. Contributions toward a monograph of the insects of the Lepidopterous family, Noctuidæ of temperate North America. Revision of the species of the genus Agrotis. By J. B. Smith. Washington, 1890. From the Trustees.

Bulletin of the United States Geological Survey:—No. 58. The glacial boundary in Western Pennsylvania, Ohio, Kentucky, Indiana, and Illinois. No. 59. The Gabbros and associated rocks in Delaware. No. 60. Report of work done in the division of Chemistry and Physics mainly during the fiscal year 1887-8. No. 61. Contributions to the Mineralogy of the Pacific Coast. No. 63. A Bibliography of Palæozoic Crustacea from 18 to 1884. No. 64. A report of work done in the division of Chemistry and Physics mainly during the fiscal years 1888-9. No. 66. On a group of volcanic rocks from the Tewan Mountains, New Mexico, and on the occurrence of primary quartz in certain basalts. From the Department.

Calendar of the University of Tasmania for the year 1891. From the Registrar.

Catalogue de la Bibliothique, Fondation Teyler. Harlem. From the Department.

Catalogue of the Chinese Imperial Maritime Customs Collection, at the U.S. International Exhibition of Philadelphia, 1876. From the Department.

Catalogue of the Australian Birds in the Australian Museum at Sydney, N.S.W. Pt. III. Psittaci. By E. P. Ramsay, LL.D. 1891. From the Trustees.

Catalogue of the fossil Cephalopoda in the British Museum Natural History, Pt. II., containing the remainder of the sub-order Nautiloidea, consisting of the family Lituitidæ and Nautilidæ, with a supplement by A. H. Foord, F.G.S. Catalogue of the fossil Fishes in the British Museum, Pt. II., containing the Elasmobranchii, Acanthodii, Holocephali, Icthyodorulites, Ostracodermi, Dipnoi, and Teleostomi, and Chodrostean Actinopterygii, by S. Woodward, F.G.S.,F.Z.S., etc. From the Trustees.

Catalogue of the Crawford Library of the Royal Observatory Edinburgh. From the Department.

Catalogue of Canadian Plants, Pt. V Agrogens, by J. J. Macoun, M.A. From the Society.

California State Mining Bureau.—Tenth annual report of the State Mineralogist for the year ending December 1, 1890, Sacramento. From the Department.

Contributions to Canadian Palæontology, Vol. III., Canada, 1891. From the Department.

Contents and index of the first twenty volumes of the Records of the Geological Survey of India, 1868 to 1887, India. From the Department.

Cyclone Memoirs, Part III., Bay of Bengal Cyclones, 1890. From the Department.

Den Norske Nordhavs, Expedition 1876-78. XX. Zoologie, Pycnogonidæ ved. G. O. Sars. Christiania, 1891. From the Department.

Department of Mines, New South Wales. Palæontology No. 7. The Mesozoic and Tertiary Insects of New South Wales. By R Etheridge and A. Sidney Oliffe. A Monograph of the Carboniferous and Permo Carboniferous Invertebrata of N.S.W. Cœlenterata. By R. Etheridge. From the Department.

Department of the Interior. Bulletin of the United States Geographical Survey. No. 54. On the Thermo-Electric Measurements of High Temperatures. No. 55. Report of the work done in the division of Chemistry and Physics, mainly during the fiscal year 1886-7. No. 56. Fossil wood and Lignite of the Potomac formation. No. 57. A Geological Reconnaissance in South Western Kansas. From the Department.

Department of the Interior U.S. Geological Survey, J. W. Powell, Director. Mineral resource of the United States Calendar year 1888, by D. T. Day. Monagraphs of the United Geological Society, Vol. XV Text, eighth report 1886-7, Pt. 1 and 2, Ninth Report 1887-8.

Flora of British India, Pt XVII, by Sir J. D. Hooker. From the author.

George Simon Ohm's Wissenschaftliche Leistungen, Munich, 1889. From the Society.

Iconography of Australian Salsolaceous Plants, by Baron Müeller. First to the Sixth Decade, 1889-90. From the Government.

Imperial Federation (a paper). Current numbers. From the Editor.

Informes Y Documentos relativos 'A Commercio Interior Y Exterior, Mexico. Current numbers, 1891. From the Department.

Jahrbuch des Norwegischen Meteroogisen Instituts for 1888. Christiania. From the Department.

Journal of Morphology, edited by C. O. Whitman (current numbers), 1891, Boston. From the Society.

Journal of the Royal Microscopical Society, England (current numbers), 1891. From the Society.

Journal of the Society of Arts, England (current numbers), 1891. From the Society.

Journal of the Royal Microscopical Society of England. Current parts, 1891. From the Society.

Journal of the Statistical Society of London. Vol. LIII., Part 3 (September, 1890) ; Part 4 (December, 1890). Vol. LIV., Part 1 (March, 1891). From the Society.

Journal of the Linnean Society of London. Zoology, Nos. 124, 5. 145, 6, 7. Botany, Nos. 175, 183, 4, 5, 6, 7, 8, 9, 191, 2,3. From the Society.

List of named insects in the South Australian Museum, Adelaide, by J. G. O. Tepper, F.L.S. From the author.

List of the Canadian Hepaticæ, by W. H. Pearson. Montreal, 1890. From the Society.

Magnetical and Meteorological Observations. Bombay, 1888-1889. From the Department.

Memorias de la Sociedad Centifica Antonio Alzate. Temo III., IV. Mexico, 1890. From the Society.

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SEPTEMBER.

The monthly meeting of this Society was held on Tuesday, September 8, the President, His Excellency Sir R. G. C. Hamilton, K.C B., in the chair. There was a large attendance of members and ladies.

The following were elected Fellows of the Royal Society :—Ven. Archdeacon Mason, Rev. James Scott, D.D.

HIS EXCELLENCY referred to the paper read on behalf of Mr. A. J. Ogilvy at last meeting on the best means of collecting scientific information, and suggested that the matter should be brought under the notice of the approaching meeting of the Australasian Association for the Advancement of Science. He considered that valuable information would be obtained if, as suggested, there was a representative of the Society in every district to keep his eyes and ears open, and let them know of anything of scientific interest.

Mr. A. J. OGILVY said he regarded it as very important that in every district the Society should have some one to represent it, and pointed out that if at any time it wanted any special local knowledge there would be somebody to whom application could be made. He thought that the Fellows should consider as to the best means of carrying out the suggestion made, and deal with the subject at a future meeting.

Mr. A. MORTON, as General Secretary to the Association, gave a satisfactory progress report *re* the arrangements for the approaching meeting of the Australasian Association for the Advancement of Science, and hoped at next meeting to present a report giving a list of the papers to be read.

ELECTRIC TRACTION.

Mr. MONTAGUE JONES, C.E., read a paper on the above subject. He said that whether the present generation had discovered the ultimate force in nature most applicable to the service of men was a question for the scientist of the future to decide, but he thought they could claim the present to be an electrical age, as in pre-historic times there were ages of stone and bronze. The practical utility of the application of electricity to the propulsion of railway and tramway cars was first demonstrated at Berlin in 1879 by Siemens and Halske on an experimental line of 500 metres, in the form of an oval. The train consisted of a small electric locomotive and carriages, which had very small wheels, with two rows of seats running parallel to the rails. The success of this experiment led to other attempts of an exhibitional nature at Brussels, Dusseldorf, Frankfort and other places, and then electrical traction passed from the experimental to the commercial process of development. The Lichterfelde electric tram near Berlin was the first of its kind. The length was 1½ miles, and the equipment in 1881 consisted of two motor cars, the motion being transmitted to the wheels by belts working on grooved pulleys outside the wheels. The prime source of power was a steam engine, with a Siemens motor and generator, but the installation differed in some respects from the Berlin line, the central rail not being used, but the one rail acting as a lead, and the other as a return for the current. Up to 1887 this line carried 100,000 passengers yearly. These instances showed that the inception of electrical tramways took place in Europe, the principle being the generation of electricity by dynamo, and conveying the current through conductors connected by sliding contact with the cars while in motion. Modern electrical railways were now built chiefly on this principle, although America had far succeeded Europe in the improvement and perfecting of the system. The remainder of the paper consisted of a description of the various systems in vogue, after which he dealt with the "overhead system," which had most successfully operated commercially and practically. Many objections of an æsthetical nature had been urged against the overhead gearing, but they were more apparent than real, and he recommended such objectors to look to the telegraph cables so obtrusively conspicuous in big towns. It was superior to other systems of traction. Traction expenses on horse tramways amount to two-thirds of entire working expenses, to say nothing of its inhumanity, and steam was a clumsy, though effective, method of applying force. He considered that the citizens of Hobart would be wanting in public spirit if they permitted steam engines to run along their streets. If a draughtsman sat down and deliberately attempted to design an affront to a decent community, he could not have succeeded better than at Sydney, where the working expenses amounted to three shillings per tram mile. It was now generally admitted that the struggle for existence lay between the cable system and the electric. The cost of the construction of the former in Melbourne amounted to £34,000 per mile and 75 per cent. of the available energy was lost by dragging the cable itself. At Minneaopolis, £80,000 was spent in the purchase of cable plant which was cast on one side as scrap iron to make way for an electrical system. The cable tramway could certainly surmount phenomenal grades, but on the other hand the electrical tramway could negotiate 1 in 8 grades, or even less. It was only a question of power, and Mr. Reis, an electrical engineer, had made some very valuable discoveries as to electrical braking and adhesion, which he hoped to see practically demonstrated at an early date. It was difficult to surmise what shape electrical developments would take place in future, its potentiality being apparently infinite, but it was no stretch of imagination to say that it was the locomotive power of the future. The various stages in the history of electric traction as described in the paper were illustrated by diagrams shown with limelight effects by Mr. Nat Oldham, and assisted greatly in conveying a clear comprehension of the lecture to the minds of the audience.

Mr. JOHN MACFARLANE said he had an opportunity of gathering information on this interesting subject, being in correspondence with the Thomson-Houston Company, makers of electric railway plant. Electric traction had left the region of scientific experiment and was an established commercial success. In the United States there were 310 tramways or railroads worked by electricity, with 4,000 cars and 7,000 motors. It was estimated that one-third of the street railway mileage in the States was worked by electric traction, and he referred to a number of companies which paid 8 per cent. With regard to steep grades he believed that 1 in 7 was not too steep for working, but he believed that the steepest grade in the proposed Hobart line was 1 in 16. It was interesting to note further that electric traction had also been successfully applied to tramways for mills and manufactories. In conclusion, he referred to the testimony as to the safety of the overhead wire system.

Mr. C. W. S. JAMES said he had been deeply interested in the paper read, and had tried to think how far the electric traction system could be applied to Hobart. A few months ago he had estimated what could be done in Launceston by utilising the South Esk River and he thought that there from 1,000 to 1,300 horse-power could be available. In regard to Hobart, however, there was not the same power available, and he believed they would require to look to generated power in any electrical system introduced. He thought the system could be usefully applied to carrying minerals on the West Coast, and that the "overhead system" was well adapted for the streets of Hobart.

Mr. J. FINCHAM said he had followed the paper with interest, but they had no reference to the length of the steep grades surmounted. He believed that in any scheme for electrical traction in Hobart this would be one of the difficulties. He was aware that there were about 300 tramways in America, but he had not been able to get any particulars as to the grade, or whether it was equal to such a grade as they had to contend with in going up Elizabeth-street.

Mr. A. W. LAWDER thought the length of grade to be overcome simply resolved itself into a question of the power of the accumulator.

Mr. FINCHAM said that was just the difficulty the engineers found. They had not been able to provide enough accumulation to overcome a sustained strain.

His EXCELLENCY, in bringing the proceedings to a close, thanked the author of the paper, and all who had taken part in the discussion. He was pleased to see such a large meeting, and was quite sure that Mr. Jones, by his interesting paper, had justified the expectations of all present.

The proceedings then terminated.

OCTOBER.

The monthly meeting of the Royal Society of Tasmania was held on Monday evening, October 12th, the President (His Excellency Sir Robert G. C. Hamilton, K.C.B.,) in the chair, a large number of ladies and members being present.

The PRESIDENT said before calling upon the Secretary to give a report on the progress of the Australasian Association for the Advancement of Science he was sorry to have to inform the members that Sir Wm. MacGregor had wired to him stating that he would be unable to be present at the meeting to be held in January. His Excellency said he was pleased to say that he had a letter from his friend Sir Robt. Ball, Astronomer Royal of Ireland, who, although unable to be present, had promised to forward a paper to the astronomical section. (Hear, hear).

The Secretary (Mr. Morton) said Professor T. W. E. David, F.G.S., Professor of Geology at the Sydney University, had been asked and had accepted the presidency of the geological section, rendered vacant by the death of Mr. C. S. Wilkinson, and for the geographical section Commander Pasco, R.N., of Victoria, had been appointed. Committees of the various sections had been appointed, and the preliminary programme was now in the hands of the printer, and would be ready in good time. Titles of papers had been received from members residing in the several colonies, and the bulk of most of the papers no doubt would be forwarded during the next few weeks. Mr. Morton referred to the recent meeting of the American Association that had met in the United State and said he hoped that, as at that meeting, at the Tasmanian gathering many ladies would take part, not only in the discussion, but would contribute papers to the several sections. (Hear, hear.) The secretary further remarked that he was pleased to say everything in connection with the coming meeting promised well.

His Excellency said before calling upon Mr. Johnston to read his paper, he would like to say that at the last meeting Mr. Montague Jones had, owing to some oversight, been unable to reply to those who took part in the discussion following Mr. Jones' paper, and he would now ask Mr. Jones to reply.

Mr. JONES said in a discussion which followed the reading of the paper on electric traction Mr. Fincham appeared to associate the "storage system" with the practical operation of electric trams, but it was clearly pointed out that the "storage" up to the present time was an ideal method, and that the "overhead system" was the only one of practical value. The main defects of the former are the limited capacity of the cells, and when brought to bear on a grade of 5 per cent. or over heat instead of current was developed, which buckled the cell plates, rendering them useless, and again, the cells are composed of lead, weighing altogether 3,000lb., which has to be carried about over light as well as the heavy grades, losing 60 per cent of the available efficiency. Coming to the "overhead system," the question of surmounting heavy and continuous grades resolves itself into a question of increased power, which is always to be obtained from the central station, and herein lies the great advantage the overhead system has over any other. All the available energy can be utilised excepting a few points per cent., due to the resistance of the current by the conductor. The maximum grade in Hobart is 1 in 16, and is slight compared with some of the towns where cars are being operated by electricity. The following is an extract from the directors of the "Richmond Union Passenger Line" to Mr. Sprague:—" The road which you have equipped under most trying conditions has been one of the most, if not the most, difficult which could be met with in street railway work. The excessive and continuous grades, the numerous sharp curves, the gradients in these curves, the weight of the cars, and the heavy roads which they have been required to carry together with the extent of the system, and the number of the cars in operation (about 40) constitute the enterprise, the largest and most difficult yet inaugurated in any part of the world. We acknowledge the successful fufilment of all the terms and conditions of the contract, and compliment you upon having achieved so signal a success." The number of street electric railways at work, and the number contemplated, is quite sufficient to prove that it has long since passed beyond the experimental stage of development. Citizens of Hobart should keep these facts in view and refuse to listen to any argument stating it to be impracticable to introduce an electric service here; the wretched apology for a permanent way will certainly have to be removed, and a neat steel grooved rail put in its place, as the basis of efficient street transit is a smooth and sound rolling surface. I would also like to see a 4ft. 8½in. gauge, instead of a 3ft. 6in. gauge, as the latter might create mechanical difficulties which cannot at present be foreseen, as all the electric roads, or nearly so, are built to narrow gauge requirements. Of course these difficulties would be overcome; still it is just as well to be on the safe side. As regards a prime source of power for Hobart, it is a simple question of cost and maintenance whether water or steam would be better. There is plenty of water, and the cost to supply a constant head would be, I think, much less than coal. Two hundred h.p. would be more than sufficient force for a service of 12 cars, and as to the mechanical power for equipment it does not make much difference whether the grades be 1 in 5 or 1 in 10, as the motors used are of a standard size, having a capacity of 15 h.p. each. Where the grades do not exceed 4 to 5 per cent., one motor could do the work, but where the grades exceed 5 and run up as high as 10 per cent., then it is unsafe to operate, except by driving both axles, and then the equipment must be two 15 h.p. motors. The average weight for street motors' equipment is about 100lb. per h.p. Hence 2·15 h.p. motor equipment will weigh about 3,000lb. I have deduced this to mathematical formulæ following:—H.P. 4·75=M.T, (C x 1), where M miles per hour, T No. of tons, C rise in feet per 100. The cost of single line "overhead" construction, including permanent way material, under average conditions should not amount to more than £3,500 per mile. This, in comparison with the cable system at Melbourne at £34,000 per mile is very marked, and the economy of the overhead system is so manifest that Mr. Henry Peabody, of Boston, wrote to me as follows, in reply to inquiries:—"There is a feeling among all Municipal Councils, where railways apply for 'overhead lines,' that the increased economy warrants their asking for a decrease of fares, hence their desire to keep quiet about their balance-sheets." Mr. James asked me to explain the Telpherage system. There are two, "the series" and the "cross ones parallel." The latter is now being operated in many places. The skips or trucks are suspended from an iron rod supported by poles, and the rod acting as a conductor, is consructed on the "break and make" principle at every 120ft. or so, taking its supply of current from a dynamo fixed at a convenient place. The "makes and breaks" are normally closed, so that a current of electricity may flow from end to end, but when the first wheel of the skip of a train touches the "break" the circuit is closed and the currentruns back to the last wheel of the train, and into the skip containing the motor and thereby energising the train. The same operation to continues at the intervals stated the end of the journey. It can be worked up to 15 miles per hour with ease, and the cost of carrying is about 1s. 2d. per ton per mile. Unlike most new inventions "Telpherage" does not persist in adhering to any principle of an obsolete type, but is an innovation so extraordinary as to pass all practical experience. As feeders to the West Coast lines nothing could be more admirable, and not as the remote future we shall see it universally adopted, instead of those useless unpayable lines and costly roads that cripple the revenue of new countries.

Mr. W. F. WARD (Government Analyst), said he did not intend to say very much, as he had expressed himself at a previous meeting. He would, however, say that he entirely disagreed with the views put forth by Mr. Power.

Mr. ALFRED J. TAYLOR, F.L.S., read the following paper, entitled "Notes on the Shell-mounds at Seaford, Little Swanport."—Among the many interesting relics of the aborigines of Tasmania that yet remain, not the least interesting are the shell-mounds that mark the spot where they formed their encampments and feasted before the intrusion of a white race had disturbed their simple and peaceful modes of living. Such shell heaps as that to which I am about to refer occur in other parts of the world, and for some time they were supposed to be nothing more particular than ordinary "raised beaches." Even now in Tasmania there are many well-informed people who cannot bring themselves to believe that the shell heaps noticeable in many places on our shores are the kitchen-middens, or "refuse heaps," of the aborigines of the colony; and it is for the information of such sceptics that I place on record the following evidence as establishing beyond all reasonable doubt the fact that they are this, and nothing more. One has only to examine these remarkable accumulations to obtain evidence of an intensely interesting and convincing character, and the results of a personal examination of the extensive shell mounds to be found on the estate leased by Mr. Samuel Drake at Little Swanport have induced me to hope that a few notes on the subject may be of some interest to the fellows of this Society.

Mr. R. M. JOHNSTON said he was very pleased to find Mr. Taylor had taken so much trouble in obtaining such valuable information dealing with the aborigines of Tasmania. The paper read by Mr. Taylor was extremely interesting from an ethnological point. He (Mr. Johnston) had paid considerable study to the working out of the shell deposits, and on a recent visit to the place referred to in Mr. Taylor's paper he had observed the remains of charred wood, proving that the great deposits of shells had been made by natives, and were not formed by other agencies.

Mr. E. D. SWAN said some years back Mr. Mitchell, who resided on the East Coast, had, at a meeting of the Society, spoken on this matter, and had been told by the natives themselves that they had de posited the oyster shells that formed the extensive deposits.

Mr. MORTON said the paper read by Mr. Taylor was a most important one from an ethnological point, the specimens collected being exceedingly interesting. Although there was a difference of opinion still existing regarding these shell deposits, from what he himself saw he could arrive at no other conclusion than they at one time were formed by natives. Although Darwin in his work "on the structure and destruction of coral reefs and geological observations on the volcanic islands," page 258, states that during his visit to Tasmania he examined several of the shell deposits, and was of opinion that while some of the mounds may have been formed by the aborigines, the greater number of these deposits he considered had been caused by a small elevation of the land. Captain Grey and other travellers have found in Southern Australia upraised shells, belonging either to the recent or to a late tertiary period. The Rev. W. B. Clarke found proofs of the elevation of the land, to the amount of 400ft. at the Cape of Good Hope. Darwin says that when visiting Tasmania he was assured by an intelligent farmer that oysters were formerly abundant in Ralph's Bay, but that in the year 1834 they had without any cause disappeared. In the "Transactions of the Maryland Academy," Vol. 1, Pt. 1, p. 28, there is an account by Mr. Ducatel of vast beds of oysters and clams having been destroyed by the gradual filling up of the shallow lagoons and channels on the shores of the United States. Darwin, when visiting New Zealand, says he observed in the neighbourhood of the Bay of Islands, that the shores were scattered to some height, as at Van Diemen's Land, with sea shells which the colonists attributed to the natives. He (himself) was of opinion that the land had been elevated. The bone Mr. Taylor had been fortunate to obtain from the shell deposits clearly showed that it had been made by the natives, and was a most valuable relic.

Mr. A. J. Ogilvy drew attention to some caves at Rocky Mouth that he had visited, and had been dwelling places of natives. On examination he felt sure many interesting relics might be found.

Mr. Taylor, in reply, said he felt very pleased at the great interest his paper had caused, and promised to lay before the Society any further information he might obtain, and also he would be pleased to present to the Museum any specimens he might have in duplicate.

Mr. W. A. Weymouth exhibited a magnificent collection of Tasmanian mosses collected and mounted by him. The collection consisted of many species, Mr. Weymouth kindly promising to present a mounted set to the Museum.

Capt. Shortt, R.N., also exhibited a choice collection of photographs of the "milky way and nubecutœ," taken at the Sydney Observatory, 1890.

THE EARTH'S CRUST.

Mr. R. M. Johnston, F.L.S., read a paper entitled "Observation on the Causes of Elevation and Subsidence of the Earth's Crust." He referred to the difficulties of dealing with a subject which necessarily rests so largely on arbitrary values for unknown data, and stated that as this was so it was obvious that any view he might tend to favour must in his own mind be attended with a large measure of doubt, and on some obscure points his judgment must be suspended entirely. As a novel theory, however, has recently been referred to by Mr. F. Danvers-Power relating to the elevation of mountain chains, he entered more fully into the consideration of those hypotheses of causation which have gained the most favour among physicists and geologists. He divided his paper under the following heads:—Formation of continental areas and ocean basins; contraction theory; the alleged expansion and contraction of the underlayers resulting from a rise or fall of temperature caused by the loading or unloading of the areas affected; expansion and contraction of the underlayers resulting from a rise or fall of temperature; Mr. Danvers-Power's reference to the supposed influence of the pressure of ocean waters upon the formation of parallel mountain chains; and concluded with the thought that good reasons had been given for rejecting the theory put forward by Mr. Danvers-Power.

His Excellency, in moving a vote of thanks to the authors of the papers, Messrs. Johnston and Taylor, said that although Mr. Ward had spoken strongly against the views expressed by Mr. Danvers-Power, in a paper contributed by that gentleman at a former meeting, the fact of having Mr. Power's paper had been the means of causing Mr. Johnston to read a most valuable paper. With regards to Mr. Taylor's paper he was of opinion that that gentleman deserved the thanks of the Society for the very valuable information he had obtained.

The meeting then closed.

NOVEMBER—No Meeting.

SOME ACCOUNT OF THE MUTTON BIRDS, OR SOOTY PETRELS *(NECTRIS BREVICAUDUS)*, AS SEEN IN THEIR HOMES AMONG THE FURNEAUX ISLANDS, BASS STRAITS, TASMANIA, FROM NOTES TAKEN DURING A VISIT TO THE LOCALITY IN MARCH, 1891.

BY H. H. MONTGOMERY, D.D., BISHOP OF TASMANIA.

My duties called me last March to undertake a trip to the Furneaux Islands. Before I started I was aware that one of the most interesting subjects for an ornithologist in that part of the colony would be the habits of the mutton bird. But the reality so far surpassed my expectations that I have ventured to lay before the Society some results of my observations. Mr. J. B. Walker has shown me allusions to the subject in old books of travel. Mr. Barnard has been good enough to furnish me with the second volume of the Tasmanian Journal, in which a short but excellent account is given of the habits of the sooty petrel, or mutton bird, by Mr. R. H. Davies. As the paper was written 45 years ago it may be worth while putting on record what I now propose to lay before you. These petrels choose islands where the soil is composed of a loose sand, covered in places by a bush with a blue flower called "barilla," where they congregate for the purpose of digging the holes in which they lay their eggs. I have heard of a rookery in Port Davey: and among the Hunters Islands they breed on Trefoil, Sheephead, Doughboys, and the Petrels. On the northern coast there used to be large numbers on Waterhouse Island, until the pigs kept by Mr. Barrett found them out, and destroyed such vast quantities that the birds deserted the place, and now there are just a few which are carefully preserved. In the Furneaux group they used to breed in much greater numbers than at present, and I venture to hope that the chief effect of this paper may be a timely movement by the Government to save from almost utter destruction an industry which adds distinctly to the wealth of the colony, and supplies a healthy article of food. At present the most important homes of these birds in the breeding season are Chappell Island (called usually "Hummocky," because of the hill in the centre), Little Dog and Big Dog Island, Green Island and Little Green Island, and Babel Island. These places are nothing more than low sandy spots, from 300 to 1,200 acres in extent, with hardly a tree (except on Big Dog Island), and covered with long yellow grass growing up to the waist. Most uninviting looking spots they appear to be. As you pass them in the day time you might fairly suppose that there was no living thing upon them except an occasional shag or a Pacific gull. I have thought that a sailor wrecked on one of these little wave-beaten spots might even starve if he slept soundly at night, ignorant that under his feet there lay concealed hundreds of thousands of birds, which, when eaten fresh, are among the most delicious of foods. About the middle of September the sooty petrels visit these breeding places, coming in at night and remaining some ten days, in order to dig their holes. They effect this with their feet, scattering the sand behind them in clouds. When this preliminary task is finished they leave their future nests for four or five weeks, and are not seen at all in the neighbourhood. In the middle of November they commence laying eggs. Mr. E. D. Atkinson has taken fresh eggs on November 21. Whether the males feed the mother birds during the period of incubation I do not know. But as the males return every evening it is probable that they do. Only one egg is laid by each female, and it is doubtful whether in the case of the egg being destroyed another is laid. I failed to enquire at what period the young bird is hatched out, but I gather that it must be at the commencement of January. On the 3rd of March I landed on Little Dog Island, and received my first introduction to these most interesting sea birds. At 6 p.m. not a mutton bird was in sight. Indeed, during the fortnight that I was cruising about in a boat I never saw a petrel in the day time anywhere. It is their habit to fly away to sea very early in the morning to distances 40 and 50 miles away, returning only when it is dusk. Whether they have long ago cleared the immediately surrounding waters of the food they require I cannot say; but it is a surprising fact that not one of the old birds is ever visible in the neighbourhood of their young throughout the day. Walking about on a rookery is a matter of no mean difficulty. The ground, always loose and powdery, is everywhere perforated with holes from two to three feet deep, about the diameter of a rabbit-burrow. Among the long grass it is almost impossible to prevent crushing down the sand and endangering the lives of the young birds by suffocation, at the same time falling headlong oneself. Just at sunset I was invited to go some two hundred yards up on to the higher ground—the island is only 200 acres in extent—in order to see the birds come in. I shall never forget that evening as long as I live. The sun was setting, leaving a broad belt of crimson on the western horizon, and soon the surrounding sea became almost invisible. Not a sound was heard except the rustling of the grass in the wind. There was no indication that there was a living thing on the island. There were no cries of sea birds. The stillness was wonderful. Presently a single dark-winged form flitted across the island and vanished again into the gloom. In another ten seconds thousands upon thousands of birds seemed to spring like magic up out of the darkness from every quarter without warning or cry of any kind. And now backwards and forwards before my dazzled sight I saw these countless dark shadows shooting with lightning rapidity athwart the last of the evening light. Still no articulate sound was heard. Nothing but the whistle as if of bullet after bullet through the air, bewildering one with the sense of numbers and of mysterious rushing life. Repeatedly a bird would dash within an inch of my head, and then wheel like lightning to one side to escape a collision. So imminent seemed the danger of arriving at home minus an ear or a nose from contact with a sharp beak that I was fain to crouch down in the long grass to escape an accident. To sit down on the ground on that particular island was possible because there were no snakes. Nothing would have induced me to have taken up the same position in the month of March had I been upon the island called "Hummocky." But of this hereafter. The minutes passed, and still this dizzy, whirling, hurly-burly of creatures continued—silent, and even awe-inspiring. Sometimes they came in squadrons of hundreds, sometimes by tens. But still they came; each bird after a turn or two sinking with unerring instinct on to its hole, finding it in the long grass and in the darkness with a certainty which was truly marvellous. It was difficult to tear oneself away from this wonderful spectacle. But at length we returned to our tent, pitched near the water's edge but still among the bushes, and all night long as I lay trying to sleep I heard the cooing and cackling of innumerable birds feeding their young in their subterranean homes, some of them apparently within a yard of my ear. At length I fell asleep, and before I awoke, at 6 o'clock in the morning, there was not a bird to be seen on the island. All the old petrels had long ago sped away to their distant feeding places. I regretted that I had not witnessed their morning exit. In its way it is as striking as their homeward journey. For, as these birds cannot fly off the ground, especially in the long grass, each one has to walk either to the sea shore or else to the top of some rock before it can take its flight. In some cases this journey must have meant a distance of many hundred yards. Mr. Davies relates in his paper, read in 1846, that the sealers showed him the manner in which they caught the old birds for the sake of their feathers, stopping up all the tracks they made except one, which led to a pit into which they fell, and were suffocated by those that crowded after them. I am thankful to say this custom does not obtain at the present time. On every occasion when I could take the opportunity I used to take up my position upon the rookery to watch for that wonderful silent rush of birds after dusk. It never ceased to charm as well as to astonish.

I will proceed now to give you some statistics regarding the numbers of these birds, based on personal enquiries from those who live by this industry. On Chappell Island on Sunday morning, March 8, after morning service, I collected all the heads of families of the half-castes, and extracted the information I am about to put before you. But first to prepare you for some astonishing figures, I quote what has been said already on this question. Mr. Davies writes that so great were the numbers of the birds returning to Green Island that "night is ushered in a good ten minutes before the usual time." And again—"I have actually sailed through them from Flinders Island to the Heads of the Tamar, a distance of 80 miles." And Flinders calculates that he passed through a flock which must have been 40 miles long. We have fallen upon degenerate days. There are whole islands absolutely deserted now which formerly swarmed with these interesting and lovely creatures. Witness Gun Carriage, or Vansittart Island, as it is called. Not a single petrel ever breeds there now, because of the culpable negligence and cruel thoughtlessness of settlers in old days. They put cattle on the island, and I confess that my indignation rises when I think of the slow agonies endured by thousands of these defenceless young birds crushed to death in their holes under the heavy tread of bullocks. I stand amazed both at the cruelty of such conduct, and at the want of foresight among the farmers. For when once the cattle are regularly placed on one of these islands the birds desert it in a body; and there is no expedient by which they can be attracted back again. So far as it is known they depart never to return. When it is borne in mind that a man and his family can earn about £4 10s. a day for nine weeks in an industry on which he actually spends nothing, which only needs that it should be left severely alone until the moment for catching the birds has come, you will wonder how anyone can be so infatuated as to turn, say, some 20 head of cattle on an island which might otherwise produce 100,000 birds annually, to be sold at an average of 10s. a hundred. This infatuation has not ceased. The islands, some of them, are being ruined at this moment, and I earnestly trust that my voice, together with that of others, will succeed in saving a wonderful industry before it goes the way that the sealing industry has nearly gone, through sheer neglect of the dictates of common sense.

On that Sunday morning I learnt that on Chappell Island (which has an area of 1,200 acres, including rocks and sand patches) there were, in 1890, 21 families at work catching the young birds for some eight weeks, beginning about the 18th day of March. They caught and salted 204,000 birds. I asked—"Did you take them all?" "No, that is impossible. We go over the holes twice, and find just as many the second time as the first. At least 100,000 young birds must escape. When the time comes for their flight the sea is covered with them." Let us consider that 100,000 young petrels then escaped. This brings our total of young birds to 304,000, neglecting those which meet with untimely deaths. Now, each pair of mutton birds lays but one egg. Therefore at the lowest computation (putting aside all barren pairs and those which had lost their eggs or young) there must have been 608,000 old birds. But this is not all. The 21 families of half-castes on Chappell Island live entirely on these birds during their season. I made a calculation with them which showed that from six to ten birds a day is the ordinary allowance for a man; and besides the human beings to be fed there are three or four kangaroo dogs to each hut, who all have to be supported on the same diet. In the two months of their stay these people ate at least 26,000 young birds. And, lastly, the parents of these young ones so eaten amounted to 52,000. So, then, we are well within the mark when we say that on any night in February there were in 1890, on Chappell Island alone, 990,000 petrels. We are accustomed to be told of the wondrous wealth added to our food resources by salmon, which cost nothing but a little watching, and come back from the sea ten times the size they went for the sake, apparently, of feeding mankind. I submit that the mutton birds are a case equally in point. That the young fresh birds are delicious eating I can testify. They taste like a very fresh herring as we know that fish in the Old Country. Broiled or fried it is a dish to set before a king. When salted they are unquestionably nutritious, and probably quite as healthful also, for delicate persons, as cod liver oil. A little barren treeless hummock in our seas produced then last year £1,020 in cash. Destroy that rookery by letting some dozen cattle roam over it and a few sheep and what is the result in the eyes of any reasonable person? What a loss to the wealth of the colony? On this very island there is a farmer who owns 40 acres of land. This he stocks with cattle and sheep. His fence runs right across the track from the only good harbour to the largest cluster of huts. The half-caste lads pull down a panel sometimes. The cattle roam over the rookeries. I have seen them there myself, and I have thought, while viewing the present state of things with regret, how easily the island could be saved from the destruction which is impending.

But to return to numbers. Little Dog Island is in private hands on a Government lease. Three families each take some 27,000 birds off patches of 40 acres in each case. To those interested in the condition of the ground for walking I make the following calculation:—On 40 acres here there must have been 40,000 holes occupied by birds, besides deserted nests. One party on Big Dog Island collected last year 40,000 birds. This island does carry cattle, but it is quite different to the other rookeries. There is a large wood at one end, and the ground is a great deal harder, the birds breeding only at one end of the island. Babel Island probably contains more birds than any of these other places. It is at the S.E. of Flinders. But the snakes are so terrible here that even the half-castes do not like working on it. Two families, however, have attempted it this year. If we take the birds on these four little islands we shall be below the mark when we compute that on any night in February there are two million six hundred thousand sooty petrels asleep upon them.

Perhaps it will interest the members of the Society to hear of another feature of these islands. I remarked that no one on Chappell Island was ever seen without a stick or a gun. It was an ominous sign, betokening the presence of snakes. These creatures do not live apparently on mutton birds, but on mice, which abound there. The young men spend Sunday morning sometimes in killing snakes. Two parties the other day started out to see how many they could get—one party brought in 100, the other 70. Nor did any one in the islands to whom I mentioned this think it an extraordinary case. One man, old Mr. Smith, the half-caste, told me that his party one year threw into a heap the snakes they killed in the two months in the course of their work, and that they numbered 600. When you consider that a man in his prime can take 1,000 birds out of 1,000 holes, in any of which there may be snakes, it indicates the nerve that is needed for this industry. As a matter of fact they rarely touch a snake by accident. There are sure signs of their presence; nor are they often in the holes where the young birds are; and these inhabited holes have also their signs. At the same time a girl of 16 pulled out two snakes in one day a year or two ago; but, then, she was inexperienced. Sleeping on the ground among the bushes on Chappell Island on that Sunday in a hut without a door, and open on every side along the ground, I was not surprised when, after an hour, I heard my companion mutter, "I am too nervous to sleep here: I am off to the boat." For my own part, though I braved it out, I was glad when the first streaks of dawn appeared in the east.

Chappell Island is bad enough, but the half-castes say that Babel is so bad that, though a moderate fortune awaits them there, they do not care to go. I may add that so barren are these hummocks that every family commences operations by stacking wood for two months, loading their boats on Flinders Island, and filling casks of water. There is neither water nor fuel in these places. I have spoken of petrels and of snakes on these islands. I could a tale unfold about another inhabitant, exceeding in numbers even the mutton bird, but I forbear. I merely allude to the dread subject of fleas. I leave to your imagination, which you may actively employ without easily overstepping the bounds of reality, the details of this theme which in that neighbourhood you can by no means put away from your thoughts—and feelings.

What practical proposals, then, can be made for the due protection of mutton birds? I have discussed the question with magistrates in the islands, with all the half-castes, and with white settlers. I think I may say that there is complete unanimity among them all. There is no doubt what should be done. One and all call for restriction. On one occasion, a fine, stalwart fellow, a half-caste, and one of the best boatmen in the world, was urging restriction. What he really said was—"I wish, sir, when you return to Hobart, you would put *strychnine* upon them." What is the sort of "strychnine" we want?

First: The wisest plan would be for the Government to resume possession of the mutton bird islands. Some are now let on lease, such as Little Dog and Big Dog. One is in a sense reserved for the half-castes, namely, Chappell Island. But on this island two white families own small patches of land, which they have bought. In both cases I believe they are honourable men, and have no wish to go beyond their rights. Why should they not be bought out? It would be but a trifling sum, and the islands afterwards would be a regular source of revenue. Some islands, like Babel, are practically untouched by anyone.

Secondly: If resumed by Government, why should not a license be taken out by every person who wishes to "bird"—so much for an adult, say, 10s., and a lesser sum for the younger members of the family? At least £100 a year could be received at once from this source of revenue. But even if the Government does not resume possession (and I, for one, earnestly trust they will take them entirely into their own hands), still the points, which are simply dictates of common sense, are these—

(*a*.) That there be a close time for these birds, just as there is a close season for quail: At present there is none.

(*b*.) That no egging be permitted. The waste in past years, and even at this time, is terrible, and there is practically nothing gained by the taking of the eggs, whereas the number of birds is materially lessened. Formerly they were eaten in large numbers. Mr. Davies states that an officer of the old settlement on Flinders saw a woman eat 52 eggs in one day. As they are as large as ducks' eggs that was a first-rate performance.

(*c.*) That a fixed day should be gazetted before which no one should be allowed to touch a bird. Persons differ whether it should be March 15 or any date up to March 20. There is great need for such an order. Families on Chappell Island have no recognised spaces on the rookery. They begin upon the same day, each near his own hut, and work outwards and upwards as they please. If one man begins too early the others are compelled to work in self-defence. There is no need to fix the close of the season. The birds arrange that by flying clean away about the middle of May, and not returning till September.

(*d.*) No fatting should be permitted. Fatting means taking the immature bird before it is ready for salting, and boiling it down for the oil. As 200 birds make about a gallon or so of oil, which brings 3s., and as those 200 birds a week or two later would sell when salted for £1, the unwisdom of the former operation is obvious.

(*e.*) No cattle or sheep should be permitted on these islands. Big Dog Island may be an exception, but there is no question the other little islands should be protected. I know how many in this colony are enrolling children in Bands of Mercy in order to teach them to be gentle and kind to all animals. I have heard of a "Dicky Bird Society," which exists for similar purposes. I invoke the aid of all such in the cause of the gentle and inoffensive "yolla"—that is the native name for the sooty petrel or mutton bird. I invoke the aid also of all who have been fascinated by the exquisitely graceful flight of these birds as they soar and wheel round the passenger steamers that ply round our coasts. The mode of killing them for the industry is painless; one twist of the neck and they are dead. A single pressure on a gland in the stomach after death and the oil escapes at the mouth and is caught in a vessel. This is legitimate, and not barbarous, for we must kill in order to eat. But it shocks all our finer feelings to think of cattle trampling upon hundreds of young birds, which die and rot uselessly in their holes.

(*f.*) An order should be issued against fires, except between May and September. It is, of course, difficult, but not impossible, to get the grass to burn in winter. At any other season it means ruin to the industry and death to the petrels.

(*g.*) Chappell Island, in consequence of the cattle that have been on it, would be the better for a year of rest. All agree as to this. But the question arises, "Where shall the half-castes go for this one year?" Could they attempt Babel? Could they go to some of those islands off Wilson's Promontory, which are said to swarm with birds, and no one touches them? I am told there are not even boat harbours in them. At any rate, Chappell Island, as being in some sense reserved for the half-castes, merits our chief attention. There need be no difficulty in carrying out these arrangements. Under the direction of the worthy magistrates in the islands and the well-known police constable everything could be at once arranged. If it is asked why such obvious regulations have not been made long ago, I answer that perhaps the chief reason is that never have these islanders recorded a vote for a member of Parliament. There has been no polling station, no registration office for them. I have wondered why a would-be member for Ringarooma (in which district the islands are included) has never bestirred himself to get fifty solid votes from the Furneaux Islands, votes which would be gladly given to anyone who would advocate their just claims and protect their industries.

If anything I have said leads to a greater interest in one of the most beautiful of our sea birds, and indirectly helps to foster a useful industry, and further the cause of humanity in the protection of the "yolla" or sooty petrel, through the instrumentality of the Royal Society, I shall have deemed it an honour as well as a privilege to have put this paper before you this evening.

DISCUSSION.

Mr. MORTON said that the value of the mutton bird industry had never been so prominently brought before the notice of the Society since Mr. Davis read a paper on the subject, which was printed in the Tasmanian journal. He looked upon it as a matter which might very well engage the attention of the Fisheries Board. He would very much like to find out from statistics whether this wholesale destruction of the petrel had decreased the numbers. As far as he was able to gather they had not decreased. It was plain, however, that were cattle were introduced the birds had disappeared and gone to some other place. Viewed as an important industry, he thought these birds should be protected, especially as it was thought necessary to protect quails, which brought no revenue into the country, but merely provided sport.

Mr. Bernard Shaw said that there was already an Act of Parliament enabling the Executive to deal fully with the matter. It was passed last session, and there did not appear to have been sufficient time to prepare the necessary regulations. Under that Act the Governor-in-Council was empowered to make regulations fixing a close season for the birds, preventing the introduction of cattle and sheep to certain islands, the lighting of fires, and various other matters to which His Lordshp had referred in his paper. He considered that interference in these matters was beyond the functions of the Fisheries Board. The Act to which he had referred gave ample powers to make all the regulations necessary, and he hoped that before next season there would be a complete set of regulations in operation.

Mr. Alfred J. Taylor said that before Bishop Sandford left the colony he brought this matter under the nôtice of the Society, and pointed out that a valuable industry was being destroyed. He had also referred to the fact that the oil of the bird had been found valuable as a medicine in cases of consumption.

Mr. R. M. Johnston said that having visited these islands on several occasions he could corroborate His Lordship's description of the return of the birds. It was a glorious sight to see the multitude of birds returning, and he was glad to see that steps were being taken to see what could be done to protect these birds. In regard to the destruction of the birds, he thought this arose not only from the destruction of the birds, but also of the mounds in which they burrowed.

His Lordship briefly replied, expressing pleasure at the fact that legislation had been initiated in the direction indicated, and hoping that the necessary regulations would be framed to protect what he regarded as an important industry.

NOTES ON A COLLECTION OF PLANT IMPRESSIONS FROM THE HENTY RIVER.

By R. M. Johnston, F.L.S.

Lower Coal Measures.

Until very recently we were ignorant of the existence of the extension of members of the Carboniferous Rocks to the west of the Eldon Bluff. About six months ago I received a collection of fossils from Mr. T. P. H. Jones, taken from a deposit extending eastward along the northern side of the Henty River, commencing at its junction with its tributary, The Badger, and apparently occupying a patch of about 4 miles square, lying between these rivers eastward of the fork. Mr. Jones states that he has traced some of its members forming a narrow curved strip bending northwards towards, and nearly approaching the vicinity of Mount Dundas.

Mr. Montgomery also visited the locality at this time, and we may hope to learn from him further particulars regarding the stratigraphic relations of the various members of this deposit at an early date. Having expressed to Mr. Jones my desire to obtain a more complete collection of the plant impressions, he very kindly undertook to do so, and recently, through the kindness of Mr. Meiring, I received a collection of Lower Coal Measure plants, containing some of the finest examples of *Glossopteris Browniana* that I have yet seen in Tasmania. One of these is nearly perfect, and must have been originally 14 inches in length, having a breadth of $2\frac{7}{8}$ inches at its greatest diameter.

Another fine example of *Glossopteris*, which I regard as a new species, is 9 inches in length, and 4 inches broad at its greatest diameter. These beautiful ferns are very remarkable, and are associated with abundant remains of the following species—all of which also occur in the shales of The Lower Coal Measures at the Mersey River: viz.:—

Gangamopteris spatulata. M'Coy.
———————— obliqua. „
Noeggerathiopsis media. Ettings.

The shales in which these plants are imbedded are hard and fissile, and of a very dark grey colour. They contain many curious botryoidal concretions; some rounded or nut-shape, and all of them having a bright glazed surface. I am yet unable to account for them.

Intimately associated with these shales occur fossiliferous mudstones and impure limestones identical with similar deposits in the Mersey, and throughout the eastern part of Tasmania.

The more numerous fossils in these beds are the following:—

Spirifera Tasmaniensis.
———— avicula.
———— convoluta.
Sanguinolites Etheridgei.
Fenestella internata.
———— plebeia.
Protoretepora ampla.
Stenopora Tasmaniensis.

There can be no doubt, therefore, that these beds are the equivalents of the Coal Measures of the Mersey, and there is some hope that Mr. Jones may be successful in his search for coal in this neighbourhood.

LIGNITE BEDS.

Mr Jones informed me that the Coal Measures at the Henty are flanked by beds of lignite, and among the specimens sent to me were several small fragments of lignite, no doubt obtained from the same place. On examination I was successful in obtaining casts of two or three new leaf forms. One of the forms is undoubtedly a species of *Fagus* with very minute leaves, closely allied to the existing *Fagus Cunninghami* of Tasmania. Another is a well-preserved impression of the phyllodium of a species of Acacia, closely resembling the existing *Acacia melanoxlyon.*

Descriptions of the principal forms of the Lower Coal Measures, together with these of the Tertiary lignites, are given hereafter.

One of the forms I have named *Fagus Jonesii,* in honour of Mr. Jones, to whom we are indebted for their discovery. Another has been named *Acacia Meiringii,* in honour of Mr. Meiring, to whom also I am indebted for placing such a fine collection at my disposal. The close resemblance which these two forms bear to existing species, incline me to the opinion that the lignites at this place are of a more recent date than any other lignite formation hitherto described.

GLOSSOPTERIS BROWNIANA.

Frond lanceolate-elongate, obtusely acuminate; costa thick, gradually diminishing, but extending to the apex; veins, close parallel, ascending from costa acutely, at an angle of about 50 deg., and gradually curving outwards, where they emerge at an angle of 30 deg. Anastomoses, long and narrow, only slightly broader close to the mid-rib. Large specimen, 14 inches long; breadth at greatest diameter, 2⅞ inches. Locality, dark shales, associated with Carboniferous Marine Beds, near junction of Henty and Badger River.

GLOSSOPTERIS OVATA. *Nov. sp.*

Frond, broadly-ovate; margin, slightly undulating; apex rounded, not produced; costa, moderately thick towards base, diminishing, but extending to apex; veins, closely parallel, diverging from costa at an angle from 11 deg. to 22 deg.; anastomoses, obscure, but do not appear to be frequent. Specimen, 9 inches long, greatest breadth at middle of frond, 4 inches. The broad, rounded form, obscure anastomoses, and the low angle at which the sharp veins diverge from mid-rib, seems to justify the separation from G. ampla to which it is most closely related.

Locality.—Henty River Lower Coal measures.

FAGUS JONESII. *Nov. sp.*

Leaves, very minute, shortly petiolate, broadly ovate or deltoid, flat, or slightly convex, coriaceous: margin, strongly dentate: mid-rib, somewhat prominent: primary veins, scarcely visible. Lignite Beds, Henty River.

ACACIA MEIRINGII. *Nov. sp.*

Phyllodium, lanceolate: apex obtuse, narrowed towards the base; slightly coriaceous, with five fine longitudinal nerves.

Anastomosing veins appear to be much closer and finer than in the existing *A. melanoxlyon* with which this form seems to be closely allied.

Length, 3⅞ inches; breadth at middle, ⅞ inch.

Locality.—Lignite Beds, Henty River; associated with leaves of extinct species.

BRIEF REMARKS ON SOME RARE TASMANIAN PLANTS.

By Baron Von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

Coprosma Petriei, Cheeseman in the transact. of the N.Z. Institute, XVIII., 316 (1886).

Under this name I wish to bring under notice what appears to be a new Tasmanian Coprosma, lately found as of rare occurrence by Mr. T. B. Moore on the highlands east of Mount Tyndall. It has the same very depressed matted growth as C. repens (C. pumila), also very small leaves and terminal small-sized fruits. But the leaves in all the specimens received are decidedly pointed, indeed ovate-lanceolar, and the fruit is beautifully blue outside, a characteristic which separates this species from all other Australian kinds, and which is not likely subject to variation. Mr. Thomas Cheeseman in his excellent review of the 31 New Zealandian species of this genus distinguished by him, mentions two as having fruits blueish outside, namely C. parviflora and C. acerosa, the former otherwise very different from our plant; the latter of much larger size, with puberulous branchlets and longer but narrower leaves. Nevertheless C. Petriei is described as varying in the outside colour of the fruit, red in the Nelson, blue in the Otago province, but possibly two species became thus confused, in which regard already some indications are given in the transact. of the N.Z. Inst. XIX., 251 and 252. As the flowers of this plant are not yet known, it remains for some future opportunity to confirm the differences existing in this respect between C. repens and C. Petriei. The fruits are globular or verging into an oval form; so far as seen on this occasion they ripen only one, rarely two seeds. The embryo is only half as long as the albument. Should the Tasmanian plant, after the flowers have become known, prove a peculiar species, then such ought to be distinguished under the finder's name.

Panax Gunnii—

The fruit of this rare shrub was also for the first time obtained for me by Mr. T. B. Moore, who gathered it in deep shady gorges at Mount Lyell, on the Canyon River, the Franklin River and on a tributary of the Pieman's River. It is succulent, about ⅓-inch broad, renate-roundish, turgid, black outside, at the summit five-denticulated and impressed, so that the styles are hardly visible; the two nutlets inside are oblique-ovate or demidiate-roundish, about ⅛-inch long, rather turgid, exteriorly grey-brown and nearly smooth. This plant seems to bear flowers already, when only 6in. high, and never to exceed 4ft. in height, unless perhaps in cultivation.

Styphelia Milligani—

Under this appellation occurs the Pentachondra verticillata in the second systematic Census of Australian Plants p. 178, in anticipation of the fruit proving that of a Styphelia (or Leucopogon), a surmise fully borne out by specimens sent by Mr. Moore from the highlands of Mount Read and Mount Tyndall, where also a small form of Acacia mucronata is growing at elevations between 3,600ft. and 3,900ft. The fruit, as now seen, is only of about ⅛-inch measurement, nearly globular; its pericarp is very thin and outside white; the putamen is five-celled. Possibly the fruit obtained may be over-aged. Until now the plant was only known from Dr. Milligan's collection. It is from 6in. to 18in. high, but as it is many-branched from the root, Mr. Moore saw individual plants covering a breadth of 2ft. When out of flower this plant calls to mind, as regards its aspect, some Pultenæas.

It may here not be inappropriate to remark that since Sir Joseph Hooker finished, in 1860, his superb work on Tasmanian plants, the following were by me brought under notice as additional among vasculares (they coming within the scope of my own researches) as the Tasmanian flora could not be kept apart in treating that of Continental Australia, some few only emanating from other collections:—

Papaver aculeatum, Thunberg.
Cakile maritima, Scopoli.
Pittosporum undulatum, Andrews.
Comesperma defoliatum, F. v. M.
Elæocarpus reticulatus, Smith.
Pseudanthus ovalifolius, F. v. M.
Euphorbia Drummondi, Boissier.
Casuarina bicuspidata, Bentham.
Zieria cytisoides, Smith.
Zieria veronicea, F. v. M.
Eriostemon Oldfieldi, F. v. M.
Atriplex paludosum, R. Brown.
Polygonum lapathifolium, Linné.
Acacia penninervis, Sieber.
Acæna montana, J. Hooker. (Recorded as a variety in the Fl. Tasm.)
Pimelea Milligani, Meissner.
Pimelea stricta, Meissner.
Pimelea axiflora, F. v. M.

Pimelea serpillifolia, R. Brown.
Eucalyptus Sieberiana, F. v. M.
Eucalyptus Stuartiana, F. v. M.
Panax sambucifolius, Sieber.
Hakea ulicina, R. Brown.
Hakea nodosa, R. Brown.
Coprosma Petriei, Cheeseman.
Cotula filifolia, Thunberg.
Calocephalus citreus, Lessing.
Cassinia longifolia, R. Brown.
Podosperma angustifolium, Labillardiere.
Ixiolæna supina, F. v. M.
Leptorrhynchus nitidulus, De Candolle.
Helichrysum Spiceri, F. v. M.
Helichrysum Gravesii, F. v. M.
Anaphalis Meredithæ, F. v. M.
Lobelia platycalyx, F. v. M.
Lobelia rhombifolia, De Vriese.
Lobelia Browniana, Roemer and Schultes.
Lobelia microsperma, F. v. M.
Lobelia pratioides, Bentham.
Leeuwenhoekia dubia, Sonder.
Donatia Novæ Zelandiæ, J. Hooker.
Scævola æmula, R. Brown.
Scævola microcarpa, Cavanilles.
Goodenia barbata, R. Brown.
Styphelia elliptica, Smith.
Styphelia scoparia, Smith.
Solanum vescum, F. v. M.
Veronica plebeja, R. Brown.
Veronica notabilis, F. v. M.
Westringia rosmariniformis, Smith.
Verbena officinalis, Linné.
Myoporum parvifolium, R. Brown.
Prasophyllum nigricans, R. Brown.
Pterostylis vittata, Lindley.
Orthoceras strictum, R. Brown.
Caladenia suaveolens, G. Reichenbach.
Thismia Rodwayi, F. v. M.
Milligania Johnstoni, F. v. M.
Potamogeton perfoliatus, Linné.
Potamogeton Cheesemani, A. Bennett.
Potamogeton pectinatus, Linné.
Zostera nana, Mertens and Roth.
Lepyrodia Muelleri, Bentham.
Calostrophus elongatus, F. v. M.
Schœnus Tepperi, F. v. M. (or a closely allied species.)
Heleocharis acicularis, R. Brown.

Gahnia Radula, F. v. M.
Carex tereticaulis, F. v. M.
Carex Bichenoviana, Boott.
Sporobolus Virginicus, Kunth.
Agrostis frigida, F. v. M.
Agrostis Gunniana, F. v. M.
Zoysia pungens, Willdenow.
Imperata arundinacea, Cyrillo.
Cyathea Cunninghami, J. Hooker.
Blechnum cartilagineum, Swartz.
Asplenium Hookerianum, Colenso.
Aspidum hispidum, Swartz.
Hymenophyllum marginatum, Hooker and Greville.
Hymenophyllum Malingi, J. Hooker. Sl.

In the concluding pages of the "Flora Tasmaniæ" were already inserted solely from Melbourne communications as additional.

Kennedya monophylla, Ventenat.
Geum renifolium, F. v. M.
Aciphylla procumbens, F. v. M.
Leptomeria glomerata, F. v. M.
Abrotanella scapigera, F. v. M.
Senecio primulifolius, F. v. M.
Senecio papillosus, F. v. M.
Dracophyllum minimum, F. v. M.
Sebæa albidiflora, F. v. M.
Limnanthemum exigeum, F. v. M.
Dendrobium striolatum, G. Reichenbach.
Selaginella Preissianum, Spring.

Addenda.

Calotis anthemoides. F. v. M. Dunalley. Bufton

Hymenophyllum rarum. R. Br. R. S. Proc. 1890.
var. Wilsoni. Hook. " " "
Doodia aspera. R. Br. " " "

THE POSSIBILITIES OF THE TELESCOPE.

By A. B. Biggs.

Up to about the end of the 15th century mankind was in a condition of helpless ignorance with regard to the nature, the distances, and the dimensions or (except two) the form of the various bodies which constitute the visible universe. No human eye had ever beheld either stars or planets as other than dimensionless points. Their motions and positions had been carefully observed, systematised and theorised upon; but they were unapproachable. What a wonderful revelation then must that have been which *Galileo's telescope* opened up! practically diminishing the distance some 20 or 30 times. True, his was a very simple affair, and feeble in its infancy; but it revealed some most important facts. It served to show that the planets at least were globes, some of them of vast bulk: it opened up to human vision for the first time the wonderful mountainous scenery of the Moon. But perhaps its most important service was to establish beyond question the Copernican theory of astronomy by revealing the phases of the inner planets—also the moons of Jupiter—a Copernican system in miniature.

The Rings of Saturn constituted an inscrutable riddle, reserved for further development of this new power of vision.

Since Galileo's time, the effort has been constant and unwearying to develop to the utmost the power of the instrument. There were difficulties inseparable from the principle on which the instrument is constructed, which it was long thought never could be overcome, the chief of which was (briefly stated) that a ray of light, when bent out of its course, as by a prism, or a lens, is separated into its different component colours, each having a different focus. The discovery and utilisation of the fact that different kinds of glass have different separating or prismatic effect, led to the construction of the *achromatic* object glass. This gave a new start to the powers of the instrument, so that we have reached from Galileo's power of 30, and imperfect at that, to a power ot about 3,000 in the Lick Telescope.

Well, now the question arises:—If we have from the time of Galileo been enabled by the gradual improvement of the telescope to stretch our gaze farther and farther into space, why should we not still go on enlarging its scope. As we now see clearly the configuration of the lunar mountains, why should we not, in time, come to see the trees growing upon there sides, if there be any? Why not discover signs of organised existence, if such exist? Is there any limit to which the instrument is capable of being developed. This is the question which it is natural to ask, and which I have been asked repeatedly. On this account I have thought it might be deemed an interesting question to discuss.

I may state at starting that doubtless there *is* a limit, and moreover, I believe that limit is already nearly, if not quite, attained. To prepare the ground for a clear understanding of my reasons, I must very briefly refer to the fundamental principles of the telescope. A luminous body, such as a star, emits rays diverging in all directions in straight lines. Of course the greater the distance the more these rays are spread ; that is, the light is diminished in intensity, and that in proportion to the *square of the distance.* Of the total light emitted that received by the eye is that fraction which the pupil bears to the whole sphere of which the radius equals the distance. These rays may be so enfeebled by distance that the object ceases to be visible. Now, if we can gather a sheaf of these rays that would otherwise pass by us unperceived, and bend them inwards until they enter the pupil of the eye, we evidently increase the visible luminosity in that proportion. This is the function of the object glass—*i.e.*, the large glass at the outer end of the telescope—or the speculum of the reflecting telescope (See Fig 1).

Of course, the larger the glass the more it can gather. As the rays from every point of the object are brought to a corresponding point at the focus of the lens, a small image of the object is formed. This image is magnified by the eyepiece, which is really a *microscope.* But whether we magnify this image less or more, we have only the same amount of light to deal with, viz., that which is grasped by the object glass ; and the more this light is spread out by magnification the more it is enfeebled. This magnification is therefore limited by the capacity or size of the object class—(other things being equal). In this respect the Telescope and the Microscope stand on a very different footing. We cannot, of course, increase the actual luminosity of a celestial object in the smallest degree. All we can do is to grasp as much as possible of the light actually emitted. With the microscope, on the other hand, we can, by means of condensers, and the employment of suitable sources of light, increase the illumination of the object indefinitely up to the required amount of amplification. Hence it is evident that increase of *telescopic power* is to be sought in the *enlargement of the light gatherer*—the object glass. But this is where the trouble comes in. The difficulty of accurately figuring a large object glass, or speculum, increases enormously out of proportion to its dimensions. If every point of its active surface does not refract or reflect its ray to its exact point in the focus, such defective part is worse than useless. To give some idea of the nicety of manipulation required, I may state that a speculum is ground and finished up to the finishing touch of fine grinding, as a portion of the surface of a *perfect sphere*. But this figure would not do at all for the telescope. The marginal rays would be reflected to a different, that is, a *shorter* focus than the central ones. The radius of curvature needs to increase as it approaches the margin. The figure needs to be *parabolic*, answering nearly to the end of a long ellipse. But so little does this parabolic figure differ from the spherical, that it is all *done in the polishing*. And this is especially where the highest skill of the manipulator is called for. An extra rub with the palm of the hand may be sufficient to distort its figure.

Then another trouble comes in, increasing enormously with the size. We cannot get size without an immense increase of *weight*, and then comes the difficulty of supporting in their tubes these heavy masses without flexure or straining, the least degree of which is fatal to definition.

But now, supposing all these difficulties successfully overcome, there remains yet another obstacle, which is utterly beyond man's power or skill to contend with. We live at the bottom of an ocean of air; and we could not exist even if we could surmount it, any more than a fish could live out of water. And this ocean is in a state of ceaseless agitation, more or less. Through this medium must pass the rays which go to form the telescopic image. Some idea of the effect of this may be formed by trying to read the inscription on a coin lying at the bottom of a clear pool that is agitated by the breeze. I have viewed the planet *Saturn* in the telescope, when, from this cause, it presented the appearance of a fire-ball; huge tongues of flame apparently blazing all round it, flickering and dancing; precisely like those *kerosene fire-balls* which the boys throw up into the air with such magnificent effect on Queen's birth-nights. It was, to all appearance, a *world in a blaze*. It is not then to be supposed that we can, whenever we please, obtain a clear and distinct view of any celestial object we may wish to inspect. Favourable occasions for this are few and far between. Sometimes a lull in the atmospheric waves permits of a momentary glimpse of the object clearly and sharply defined; just as, in the case of the coin in the pool, a brief lull in the breeze allows you to begin to read the inscription; but before you get half-way through another puff comes up and blurrs it all over.

Now this difficulty increases with the size of the telescope, inasmuch as that the larger diameter takes in a greater number of these disturbing atmospheric waves; for which reason the observer has often temporarily to reduce the effective aperture, that is, the *power* of his telescope.

The only possible amelioration of the obstacle referred to is to leave as much as possible of this disturbing medium below the observer. This is just what is done in the case of the great *Lick Telescope*, which is erected on a mountain in San Francisco at an elevation of 4,300 feet, or about the height of the top of Mount Wellington. This, coupled with its vast size and perfect finish, places this instrument in the advance post of telescopic power. It has lately been proposed in France to erect an Observatory on one of the Alps, at an elevation of 15,000 feet. Owing to the compressibility of the atmosphere by the superincumbent weight of the upper strata the half of the entire mass lies somewhat below an elevation of three miles, although the rarer air probably extends considerably over 100 miles. But the necessity of air and warmth places a limit not far to reach in this direction. The most daring of balloonists ventured up to an elevation of about seven miles (I speak from memory), when one of the occupants became insensible, and his companion had only strength left to release the gas with his teeth, having lost the use of hands, and descend into a denser atmosphere.

Assuming that I have fairly stated the case, it would appear then that the smallest advance in telescopic power is necessarily to be obtained only at a cost enormously out of proportion to the gain, or, as it is commonly expressed, "the game is not worth the candle."

One word with reference to the announcement of a new optical glass for the manufacture of telescopic lenses, about which a deal of tall talk has been indulged, and probably not a few hoaxes, with more yet to come. This sort of talk springs from an entire ignorance of the function of any such glass and a supposition that some magical magnifying power is inherent in the glass itself instead of in the skill required to shape it. The function of such glass is simply to combine more accurately the different coloured rays, which existing combinations fail, to some extent, to bring to a common focus, the result being more perfect definition.

A brief explanation will, I think, serve to make this clear. *Light* passes in *straight* lines through a uniform medium. On entering a denser transparent body the ray is bent towards the substance of that body (See Fig. 2).

But what we see as *white* light is really composed of the blending of all the colours of the rainbow, together with some other rays, viz., the actnic or chemical rays and the heat rays. Now, these latter, together with all the different colours, are unequally "refracted" or bent. The light is, in fact, decomposed. Of the *light* rays the *violet* is the most bent, the *red* least. They are thus spread out into a band, along which the different colours are distributed. A simple lens, such as that of the primitive telescope, is *prismatic.* The effect is that the red rays are brought to focus at R, and the voilet to a shorter focus at V, the other tints lying between. Thus there is no definite focus (See Fig. 3).

We have, then, two effects from the passage of a ray through a *prism*—the *bending* or *refraction,* and the *decomposing* or *dispersion.* But the grand discovery was made that different kinds of glass *disperse* or spread the colours in different degrees with a given amount of refraction, thus:—If the former prism had been of *flint* glass instead of *plate,* and made to give the same amount of bending, we should have had the different colours spread over, perhaps, double the space. To produce an equal spreading of the colours we shall require a *flint* glass prism that will bend or refract *less.* We shall require to bend the ray only to B instead of to A (Fig. 2); that is, we shall require a thinner or less angular prism. Now, place these two prisms together in reverse positions, and what will be the effect? The ray will be partially brought back towards the straight, viz., to C instead of to A (See Fig. 2 b), leaving still an amount of deviation, from the greater thickness of the *plate* glass. But the dispersion of the colours is in *reverse* order in consequence of the inversion of the prisms, but in equal degree. The complimentary colours are therefore superimposed, and are re-composed into *white light.* This is the secret of the vast advance in telescopic power since the days of Galileo.

Now to apply this to the telescope. The lens (*P*) of *plate* glass (see Figure 4) is backed by a concave of *flint* glass (*C*) of less refraction power, thus leaving a surplus of refraction to the convex, the effect being that we get a focus at *F* instead of at *f*, with all the different coloured rays brought to a common focus.

Now, there is one trouble that has not yet been surmounted. Although the *general* prismatic dispersion may be equalised and neutralised, the colours are *unequally* distributed by the two kinds of glass. Consequently one particular coloured ray does not meet its exact complimentary in the reversed spectrum, and as a result we have a fringe of outstanding colour. This is called the "irrationality" of the spectrum. This is what opticians are endeavouring to get rid of by the invention of a glass that will locate the different colours in the same relative position as does the plate glass of the convex, and this is all the *magic* there is about it.

POSSIBLE POWER OF THE TELESCOPE.

I think many persons entertain very exaggerated ideas of what the telescope in its present stage can really accomplish. Theoretically it is assumed that the utmost available power of the most perfect instrument, and under the most favourable circumstances as to the state of the air, etc., is 100 to the inch of aperture. This is the *extreme*, rarely reached. The Lick Telescope has an object glass 36 inches in diameter. Considering the necessarily immense thickness of glass through which the light has to pass, we may assume 3,000 at the utmost of its power. This should, if definition were perfect, give us a view of the moon as at a distance of 80 miles. Of course this is a vast approach. But what could we see of the details of a terrestrial mountain, supposing we could discern it at 80 miles distance? This estimate is, of course, on the supposition that we could eliminate all optical imperfection and atmospheric disturbance, both of which are impracticable. In connection with this question I made the following experiment the other day:—I approached a handbill, of the subject of which I was ignorant, until I could just make out the boldest type. I found the distance 16 yards. The letters were bold block letters, 1 inch in height. Reckoning from this, similar letters on the moon's face, to be seen by natural unassisted vision, should measure 417 miles. There would be room across her face for a word of five letters. With a telescopic power of 3,000, and no imperfection introduced, such letters, to be readable, would have to be 244 yards. Each letter would thus cover a space of about 12 acres. Allowing for imperfection, I think this would be the smallest patch that would be discernible at all as to shape. At the distance of Jupiter this object would need to be about four million times larger in surface, or, say, three times the size of Tasmania.

PHOTOGRAPHY.

There is one direction, however, in which the powers of the telescope are in process of development to a considerable extent, that is, by its association with photography. I have so far dealt with the telescope as a *seeing* instrument. Whatever is to be seen is seen at once. We cannot increase its vividness or distinctness by prolonged gaze. If a faint star, *e.g.*, is not at once visible when the eye is directed to its position, any amount of staring at it will not bring it into view. Not so with *photography*. The more it looks the more it sees. In this way it has been arranged to explore the entire heavens to depths far beyond the limits of telescopic vision by combined effort of all the principal Observatories in the world. Already vast numbers of minute stars have impressed themselves upon the photographic plate that would probably for ever have remained beyond the power of actual vision. To accomplish this something more is necessary than merely focussing the object upon the photo plate. It has to be kept there accurately during the whole time of the exposure—a needle's point to a spider line—and that for hours, against the diurnal motion of the earth. To give the proper motion to the telescope the most accurately constructed driving clock-work is necessary. For planetary detail, however, I much question if photography will ever render much service. There is no getting over the blurring caused by atmospheric disturbances, superadded to instrumental imperfection. The photo of moon from the great Melbourne telescope is generally accounted one of the most successful ever produced. But in this, minute details that are distinctly visible in either of my comparatively small telescopes are totally absent.

A few remarks on the necessity of *caution* in rightly interpreting telescopic appearances may fittingly conclude this paper. A novice on taking his first peep at the planets, we will suppose, will probably feel quite disappointed that the object he sees exhibits very little of the detail or appearance of that same object as depicted and described by experienced observers, and after long and diligent observation. The eye requires considerable training for this kind of seeing. Moreover, considerable judgment is necessary in rightly interpreting what we see.

ERRATA (IN PLATE).

Omit the words "Page A," etc.

"In FIG. 2 *b* add a dotted line (A) from prism, above C."

Figures for

Page 3 "Possibilities of the Telescope.

FIG. 1.

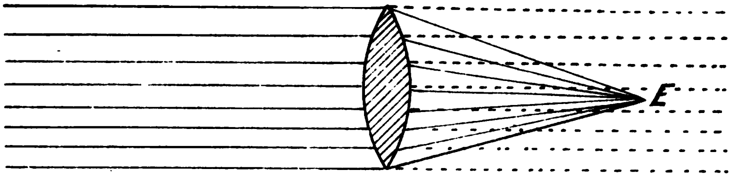


FIG 2,
Page A.

FIG 2b
Page A.

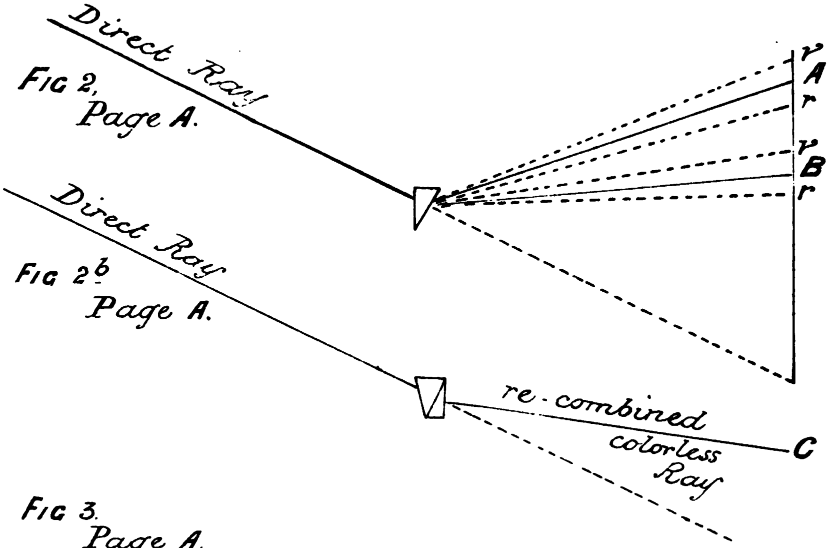


FIG 3.
Page A.

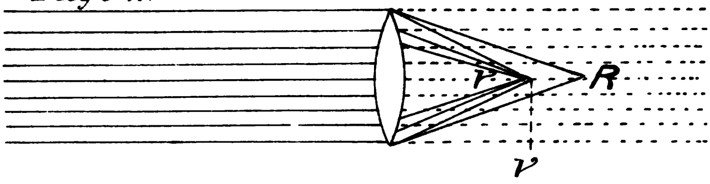
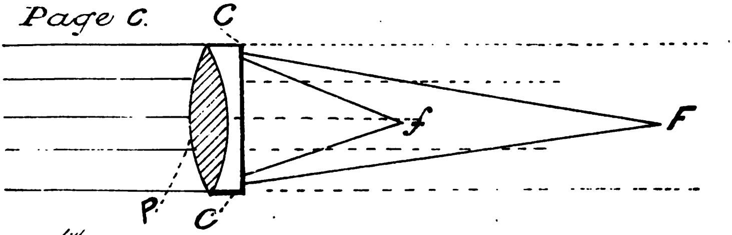


FIG 4.
Page C.



Mercury. litho.

NOTES ON THE MOUNT LYELL DISTRICT, TASMANIA.

By Frederick Danvers Power, F.G.S.

(Corresponding Member Royal Society of Tasmania.)

On taking a casual glance at the geologically coloured map of Tasmania we are struck with its similarity in appearance to some huge concretion, for we see a nucleus of greenstone, which is surrounded more or less by a ring of the upper coal measures, and these again by rocks from other epochs.

If instead of the geological map we take a topographical one we will observe the same onion-like structure. In the centre we find the Lake Plateau country, from which the river systems of Tasmania radiate. Encircling this are various ranges of mountains, and finally we have the sea coast, which has practically the same contour as the kernel, making due allowance for irregularities, which would be exaggerated by enlargements. Looking at the island as a whole, it is heart-shaped, and somewhat similar in outline to the continents, inasmuch as it is widest at the northern and narrowest at its southern end, its length being north and south. The geological and topographical features coinciding so closely, we are naturally led to the conclusion that they must in some way or other be intimately related. If we can further connect our ore deposits with the physical developments of the country we may gain something by our studies with which the strictest utilitarian cannot find fault.

Orography.

Mr. R. M. Johnston supposes that many of the Tasmanian mountains are due to the shrinkage of the earth's crust; but it has long since been proved that the elevations of our mountains are far in excess of that required by the cooling of the world, and although some slight puckering of the surface may be due to this cause, still I believe it will be generally conceded that other agencies are also at work, and that the presence of the ocean is the greatest of these.

We almost invariably find that the highest mountain ranges have been developed more or less parallel to the past or present sea coasts that are washed by the largest bodies of water. Thus in South America we find the Andes on the west higher than the mountains of the east coast; also that the western shores of America are washed by the Pacific Ocean, which is greater in area and depth than the Atlantic, which is on the eastern coast. Coming nearer home for an example, we find the highest Australian mountains on the east coast, the Pacific again being larger than the Indian Ocean. In Tasmania, however, matters are somewhat different, for there is an unbroken stretch of water from its west coast to South America; while on its east coast, some twenty degrees distant, New Zealand acts as a breakwater, and braces up the ocean, so to speak, relieving the east coast of Tasmania of much pressure from the main body of water. Therefore we are not surprised to find that the backbone of Tasmania is on the western side, especially when we find a map in Wallace's "Island Life" showing the deep water on the west coast at 2,600 fathoms, against 2,000 fathoms on the east coast. We not only have the horizontal pressure of the ocean, but also the vertical pressure, and the force is not a steady one, but varies with the tides, this movement being more effective in shifting the earth's crust than a dead pressure. The pressure of the immense bodies of water in the oceans are working as hard to-day in the building up, and indirectly in the pulling down, of our mountain systems as they have in the past, and it makes its pressure felt second-hand by the enormous weight of the rocks that they pile up, which in their turn exert a vertical pressure. We generally find that the actual coastal range is not so high as the next inland one, as if the force causing the mountain system had limited the area on which the range nearest to it could draw; also that the ranges following the main one are lower and further away from each other as they go inland. So in the case of Tasmania we find the West Coast Range comparatively low. Then comes the Main Range, including the Frenchman's Cap, Eldon Range, and the Cradles, which are among the highest mountains of Tasmania. These are followed up further inland by the King William Range. These ranges are like immense fossil waves rolling inland. They have a long slope on their western side and a steep one on their eastern, just as if they had been pushed up by the sea. Having taken a flying survey of the physical features of Tasmania we will now make a few remarks relative to the mineral wealth of the West Coast, and more particularly to the Mount Lyell district.

GEOLOGY.

The West Coast of Tasmania is rich in the variety of its minerals, among which ores of the following metals are found:—Tin, gold, silver, lead, zinc, copper, iron, chromium, nickel, bismuth, wolfram, iridium, antimony, manganese, and mercury; also other minerals of commercial value—*e.g.*, marble, serpentine, asbestos, lignite, etc.

Mount Lyell (named after the celebrated geologist, Sir Charles Lyell)—and its district is a most interesting one from a geologist's point of view, for here we have two or three different types of ore deposits. The most widely known, perhaps, is that called the "Iron Blow," on account of the hugh boulders of hematite (specimen 556) outcropping on the surface. Mounts Lyell and Owen (named after Professor Owen) are two peaks of the West Coast Range, divided by the Linda Valley, but connected on their western slopes by a saddle, which forms a watershed, the drainage on the east flowing down the Linda into the King River, and that on the west finding its way into the Queen River. That portion of the Iron Blow worked by the Mount Lyell Gold Mining Company is situated on the eastern side of the Mount Owen end of the saddle. The country rock about here consists of sandstones, green—(specimen 546) and red (specimen 551), bleached at the surface (specimen 553); various schists—ferruginous (specimen 550), talcose (specimen 548), hydromica (specimen 547), etc.; and limestone (specimen 552), which has a schistose structure. The general strike of these rocks is approximately parallel with the West Coast Range, and also the sea coast in these parts. The older rocks are overlaid with a quartz conglomerate (specimen 549), which caps the highest points of Mounts Lyell and Owen.

The Iron Blow Deposit.—Mr. G. Thureau believes this lode to be due to thermal action, but after carefully going over the ground three or four times I failed to find any facts which would confirm this theory.

Some people are pleased to consider this a so-called "true fissure lode," but this fissure theory, which has been applied to the majority of lodes, is fast dying out, for, assuming a fissure to be formed for the sake of argument, any man accustomed to mining is aware that conditions which would enable the walls of that fissure to keep open until the intermediate space was filled up with mineral matter by means of water must be very rare indeed. If the country rock has simply been loosened by some dynamical agency, or even if a fault caused a fracture and displacement of the rock, any cavities due to irregularities of the walls would be filled up with rubbed off portions of the sides which have been loosened by the movement, thus packing the space between the walls like mullock in a worked-out lode. There is, then, no fissure, and the whole affair must be relegated to an exaggerated form of loosened country, the interstices of which are filled with metallic minerals brought in by solution, which cement together the brecciated and powdered rock, sometimes even replacing it. However, the Iron Blow shows no signs of this, but, on the contrary, gives every indication of belonging to that class of deposit known as segregation lodes.

The two prevailing tints that the sandstones and schists assume when not bleached are green and red. Some of the bands of rock appear to have concentrated more iron than others, at the expense of their neighbours, and at times we get very dark shades indeed; in fact, in places it is completely turned into hematite, which retains the same laminated structure that the original rock possessed. This transformation can be traced in its various stages until we come to what we may consider the adult or perfect state, as exhibited in the Iron Blow. This deposit has not been actually traced for any great length, but a similar class of stone has been found here and there on its course so far north as Mount Sedgwick, but whether these outcrops belong to the same layer of altered schist or to parallel ones will not interfere with any interpretation of their segretative character. Although the Iron Blow is composed for the most part of hematite, it is not on account of its iron that it is worked, but because it is found to be the matrix for gold. Besides hematite we also find a fair amount of baryta (specimen 558), but, curiously enough, very little quartz. The footwall is red sandstone, with quartz, and the hanging wall iron pyrites, which we will speak of later on. The general strike is nearly north and south, though locally both strike and underlay vary considerably, which is just what one would expect in a disturbed country like this. The hematite may be divided into two classes, according to its hardness, these occurring in alternate bands, the softer portion looking as if it had been loosened by friction.

We now come to a very important point. There has evidently been some great strain about here, as indicated by cracks in the sandstone and conglomerate filled with quartz, and in the limestone, occupied with calcite; also by the fact that the conglomerate found on the tops of the mountains only occur in broken patches on the saddle. I am inclined to think that as the peaks of Mounts Lyell and Owen were formed the land piled up at those points was robbed from what are now valleys, the dragged out appearance of the country leaving one under that impression. The great weight of these accumulations could not be without effect on the weakened neighbourhood, and when settling down it would have the same effect as if one were to catch hold of opposite ends of a pamphlet and press them towards each other, if I may be allowed to make use of a homely illustration. If this took place after most of the Iron Blow hematite was deposited it would account for some of it appearing to be rubbed up along the lines of least resistance, which are coincident with the planes of bedding and cleavage. It would also account for another deposit adjoining the Iron Blow, though entirely distinct from it. On the hanging wall of the hematite, as before mentioned, is a large deposit of iron pyrites (specimen 555). If we examine the structure of this we find that when undecomposed it is inclined to be schistose, and has a remarkably close, dense texture. The boundary between this pyrites and the hematite is very sharp, which is what we would expect if due to the cause I suggest; for if such a settling down of the mountains on each side took place after the hard hematite was segregated, there being little cohesion between the hematite and the softer schists, a rupture would most easily take place between them; and the hematite, not yielding so readily to pressure exerted end on to its grain, would break up into fine particles that could occupy any loosened portion of its body; while the country rock, being more flexible, would bend rather than break, and so remain porous until infilitrated mineral solutions filled up all the spaces. The country rock about the iron pyrites deposit occurs at various angles of strike, as if wrapping round it, and the talcose schist illustrates the lenticular nature I have tried to describe on a small scale. There are no signs of sudden rupture having taken place here, but everything points to a gradual motion, which in all probability is continued at the present day. Associated with the iron pyrites we find galena; also copper pyrites, with its resulting secondary minerals—viz., malachite, azurite, cuprite, and native copper. The pyrites deposit occupies a depression or gully running 25 degrees W. of N., the hollow evidently being formed by the decomposition of the pyrites, a large portion of it being dissolved out by water in the form of sulphate of iron, while that which is oxidised into gossan remains behind as a thin capping, until denuded by atmospheric agencies. I account for the pyrites being found so near the surface by the fact that the country here is very moist, a peaty water oozing out of the button grass, the reducing action of which would retard oxidation. I also credit this water with being the agent that reduces the silver and copper which we find in the neighbourhood. The water is so darkly coloured that one almost suspects Neptune of having upset his billy-can of tea. The mass of the pyrites is very poor in gold, but the gossan (specimen 559) or iron capping in places contains a fair amount. This is only reasonable, for a ton of gossan is greater in bulk than a ton of heavier pyrites, and since a ton of gossan must be the product of decomposition of much more than a ton of pyrites, the former will naturally contain the gold concentrated in it, unless washed away mechanically, but the vesicular nature of the gossan tends to prevent that, and the sulphate of iron formed would prevent it being carried away in solution chemically. The decomposed pyrites, when placed on litmus paper and moistened, shows a distinct acid reaction, and this stone, when passed through the battery, unless well leached first and washed with alkaline water, will eat into the plates and sicken the quicksilver.

The Linda Valley Alluvial.—Most of the creeks flowing into the Linda Valley are found to be gold-bearing, as is also the alluvial of the valley itself; in fact, it was by following up the auriferous debris to the foot of the Iron Blow that this now well-known deposit was discovered, and for this reason it is generally considered that the gold found in the low country was shed from the hematite. I have carefully examined some specimens found in the alluvial, which show gold clinging to its matrix. In some instances, it is true, we find the gold attached to hematite, but we also find it sticking out of quartz. However, specimens of either sort are rare, even at the head of the gullies, the gold being, as a rule, clean and in fine grains. Now, I believe that most of the gold and alluvial found in the Linda Valley—and for the matter of that, in the neighbouring creeks also—is derived from the conglomerate which caps the mountains hereabouts. My reasons are these:—

1. There is no earthly reason why gold should not occur in the conglomerate if it were formed from a gold-bearing country, and we know the West Coast to be auriferous in several places.
2. The alluvial at the head of the Linda Valley is water-worn, and composed for the most part of quartz pebbles. In such a position the quartz, if originating from close by, could not have travelled sufficiently far to be so rounded, besides, there is not much quartz in the neighbourhood, the rocks being mostly schists and sandstones.
3. The saddle at the head of the valley connecting Mounts Owen and Lyell has very little conglomerate left on it, though traces here and there can be seen that could not possibly have fallen down from the higher mountains. If the conglomerate originally on the saddle was ruptured and loosened by dynamical strains it would be the more easily disintegrated and washed down into the valley by sub-aerial agencies than the less disturbed and more solid rock on the mountains, which would account for our not finding much conglomerate left on the saddle; then, again, the pebbles composing the gravel of the alluvial in the valley are similar in size and nature to those found in the conglomerate.
4. Boulders of conglomerate can be seen in various stages of decomposition on the sides of the mountains and in the alluvial of the valley. I have washed the product from a decomposing boulder standing isolated on its way to a gully below, and have obtained a colour of gold. On making

enquiries from local miners, two of them—Jack Fehey and Steve Karlsen—informed me that they had also obtained gold from the conglomerate wash at different times.

5. That portion of the alluvial deposit which is composed of broken up schists is very poor in gold; that made up of red standstone drift is better, while that consisting of quartz pebbles is the best, and we seldom get a "duffer" dish from it. At Karlsen's face they average about five grains per lode, while at the Linda Valley claim they estimate four and two-eleventh grains per cubic yard of dirt.

The alluvial at the head of the Linda Valley is evidently not in its original position, as can be seen by the high angle at which it is found, for the gravel, sand, clay and lignite, all of which have different angles of rest, are tilted up to such a degree that proves they could not have been deposited in such a situation. Some people shirk the necessity of explaining the problem of the Linda Valley alluvial by saying that the whole mass has been turned topsy-turvy, but there are no signs of such a general mixing up: the tilting of the deposit from the original angle of deposition is all we require to make the whole affair clear, and such a movement in the earth's crust has evidently taken place here, as the bed rock is thrown out of its normal course. The richest portions of the alluvial is found to be the top and bottom gravels, and wherever certain small, heavy white pebbles, termed locally "Sailor Jacks," occur payable gold is sure to be found. At Delany's face they have obtained good results from the former, and at Karlsen's face first-rate gold has been won from the latter. Some persons suggest that the alluvial is simply conglomerate, which has slipped down bodily from the mountains; but this can hardly be the case, as the alluvial is quite loose, while the conglomerate is very compact; besides, the former is associated with lignite which we do not find on the heights above, thus proving that the gravel was deposited gradually where now found, and that the conditions then prevailing were favourable to a dense undergrowth. The presence of occasional patches of gravel in the lignite shows that the original organic mass grew in shallow places subject to floods, and it is only in such spots that we find gold in the lignite, this going to prove that the gold in the alluvial has been deposited mechanically, and not chemically, otherwise we would expect to find it richer near the lignite, which would tend to reduce it from solution, either by virtue of the organic substance itself, or else by the sulphuretted hydrogen given off by its decomposition. Drift wood may have contributed somewhat to these lignite deposits (specimen 561), but owing to their depth I consider most of the vegetation grew *in situ*; well preserved samples of King William pine (specimen 563), and leatherwood (?) (specimen 562), can in places be picked out, and sometimes the ligneous matter has collected iron pyrites about it (specimen 560). A little cement is now and again to be met with: this in all probability was caused by pyrites being formed, an opportunity being given to the iron present to obtain sulphur from the decomposing vegetable matter, and the more heavily charged water finding its way to the comparatively stagnant bottom would cement the pebbles together. In course of time, as the deposit was drained, this pyrites would become oxidised, as we find it at the present day in Karlsen's face. Many of the streams on the Mount Lyell side of the gully have been worked for gold, until the heavy conglomerate boulders have become too numerous to remove. Besides gold, native copper is also obtained.

Mount Lyell Copper Deposits.—On tracing the alluvial copper to its source we are led to a zone of decomposed schists, forming a pug—grey, yellow, and red—some hundred feet broad. Where cut by the creeks this zone would appear to be equally productive throughout, as the tenacious clay retains most of the copper that is shed on to it; but when we clean up the bed of the watercourses we find the copper is confined to three distinct deposits, which run parallel, from two feet wide downwards. Where the pug is comparatively dry, a little below the surface, it flakes off in pieces corresponding to the cleavage plains of the shale; while the copper is found in sheets, as if occupying the joints and cleavage plains of the original rock. These sheets of metal, which at times are fairly thick, get broken up into small nuggets, shots, and spangles, which are more or less coated with the black oxide of copper. Below the native copper we come across cuprite, which occurs in beautiful crystals, mostly octahedrons, with their edges truncated by faces of the rhombic dodecahedron. No doubt the native copper has been reduced from this by the agency of the peaty waters. Still deeper than the cuprite we come across copper pyrites, which takes upon itself the same form as the rock which it impregnates; in fact, it might be termed a cupriferous schist. Instead of copper pyrites the rock may be charged in a similar manner with iron pyrites, or both. When the latter takes place the copper pyrites is found concentrated on one side and the iron pyrites on the other, and when the deposit crops out at the surface the iron pyrites resolves itself into the oxide, which is sometimes accompanied with pyrolusite.

In presenting the above remarks to the members of the Royal Society of Tasmania I have carefully weighed the ideas and opinions of others who have visited the locality I refer to.

If the glasses through which I have viewed the works of nature will not allow me to agree with the interpretation that other observers have thought fit to make, I cannot be accused of having drawn on my imagination to obtrude a pet theory upon your notice, for I have endeavoured to give a correct description of matters as they at present are found, and to point out how, by using such forces of nature as are to be seen at work at the present day, such results could be brought about, not forgetting that time is an unlimited factor of nature's that enables her to produce results slowly, yet surely, in the world's laboratory, which man, during his short space of life, can never hope to attain by the same means.

DISCUSSION.

Mr. R. M. Johnston, F.L.S., in reply to Mr. Power, said:—Of the many hypotheses advanced at different times to account primarily for the oscillations of the earth's surface it is frankly acknowledged by those who espouse one or other of them that all are open to objections of some kind.

There are three hypotheses, however, ably supported by celebrated physicists, which severally seem to find greatest favour among geologists, some espousing the one and some the rival hypotheses. These three hypotheses are mutually exclusive, and may be briefly described as—

1. The contraction or cooling globe theory.
2. The gradation or surface displacement theory.
3. Mobility of a hypothetic fluid theory.

Undoubtedly the first of these has obtained the greater acceptance among geologists, owing mainly to the able advocacy of Robert Mallet; and although it is admitted that there are serious objections to its acceptance (notably those urged by Mellard Read in his "Origin of Mountain Ranges"), it is even now variously modified, the most widely accepted among geologists as furnishing an explanation of the origin of the upheavals and subsidences of the earth's crust. Such is the opinion of Dr. Geikie in his last great work.

The rival theories, though ably supported, have even greater objections urged against them, and even one of the most formidable opponents of the contraction theory in Australasia, Professor Hutton, cannot urge that it is disproved by the demonstration of the truth of any other hypothesis. In his able address before the A.A.A.S. he states that "During the last fifty years investigation has rather been destructive than constructive, but progress has been made. Formidable obstacles have been removed . . . No doubt the outlook is still foggy, but the horizon is clearing, and we may hope that when we have fuller knowledge of the movements of the crust we shall find a clear explanation of their cause." Until that time arrives we must be content provisionally with that hypothesis which seems to account most reasonably with the greater number of known facts. The proof of a more perfect theory has not yet been made evident.

MR. STEPHENS, F.G.S., said that the author of the paper under consideration had evidently paid much attention to the geological formations of a portion of the Western Country, but, in dealing with the question of the history of the mountain systems and the general physical structure of Tasmania as a whole, he appeared to have relied too much on the information supplied by maps, which is necessarily very imperfect. That the chief agency at work in producing those undulations in the primary rocks which had brought into existence many of the mountain ranges and valleys of Tasmania might be traced to secular cooling and contraction of the earth's crust there could be little doubt, and the mountain systems of later date owed their origin indirectly to the same cause, though the valleys had, for the most part, been scored out by the ordinary processes of nature working on the surface of the country. In addition to what had been said in opposition to Mr. Power's water pressure and wave theory, it might be pointed out that until portions of the crust had been raised there was no deep sea, and therefore all that the weight of the water could do, if it had any effect at all, would be to moderate the downward pressure of neighbouring mountain ranges, which are always in a condition of continuous resistance to the forces which had elevated them. With reference to Mr. Power's remarks on the conglomerates of the West Coast, there could be no doubt that, as he suggests, some of the gold in the alluvial deposits has been derived from conglomerate formed from the waste of auriferous rocks. On the other hand it has to be borne in mind that, while there are many conglomerates interstratified with the primary rocks, and likely to contain gold in cases in which the cemented materials have been derived from auriferous veinstones, there are other conglomerates of more recent date which have been derived from bands of quartz rock, quartzite, and associated schists, such as occur in great force at Mount Arrowsmith, Rocky Cape, and elsewhere, in which no gold occurs to any appreciable extent.

Mr. A. MONTGOMERY, M.A., Government Geologist of Tasmania, regretted the absence of Mr. Power, as he would have liked to have had from him further explanation of the new theories advanced. The subject matter of the paper had a very wide scope, comprising two new theories, one of the formation of mountain chains, and a second of the origin of lodes in general, and of the Mount Lyell lode in particular.

Each of these subjects was quite large enough to require a separate paper for its elucidation. Taking the new theory of mountain elevation first, the writer referred to Mr. Johnston's supposition that many of the Tasmanian mountains are due to the shrinkage of the earth's crust, and dismissed the whole contraction theory with the cursory remark that "it has long since been proved" that that explanation was insufficient. He thought that many other geologists would agree with him (Mr. Montgomery) in denying that any such thing had long since been proved. While it might be conceded that other agencies were at work, he did not think either that many would agree that the mere presence of the ocean was the greatest. The subject of the rate of the cooling of the earth and the contraction consequent thereon was a most abstruse one, and there had been great difference of opinion expressed about it. In his mention of the higher mountain ranges, the writer left out of account the great range of mountains extending from the west of Europe to the east of Asia, and right away from any large body of water. The theory enunciated was that the mere weight of huge bodies of water pressing on the crust of the earth forced up a part of the solid crust to a higher level, and he failed to see how such a thing could happen. Water could only raise water to its own level, and could not raise a heavier substance to a higher level. The theory brought forward to account for Mounts Lyell and Owen was a curious one, and he could not see the probability of it, unless indeed the change was ascribed to some grabbing influence from outside the earth altogether, that being the only sort of force that could rake up the material from the valleys and give the country a "dragged out appearance." This and the further reference to the effect of "the great weight of these accumulations" which are no sooner raised up than they begin to settle down again, presumably directly against the force that has just raised them, led one to think that the writer must have based his theory on the supposition that the whole crust of the earth was a jelly, and he suggested that this theory might be known as the Jelly Theory, to contrast it with those generally accepted. The "homely illustration" of the pamphlet was not a good one, as the forces there applied were two lateral ones in opposite directions, while that to be illustrated by it was one force acting vertically. The writer stated that the "fissure theory, which has been applied to the majority of lodes, is fast dying out;" but his impression was that 999 out of every 1000 geologists or men connected with mining would hold that theory as one that met the greater number of cases, and assert that true lodes were almost universally found to be fissure deposits. It was a fact that such packed spaces as alluded to by the writer as being sure to occur if lodes had once been fissures were common in lodes. The difficulties of imagining that a lode fissure could be kept more or less open disappeared when it was remembered that fissures were generally uneven, and that "faulting," even to a very slight extent, would result in a series of more or less connected but irregular cavities. That many lodes were lines of fault was well known. He instanced the case of the Tasmania reef at Beaconsfield, which crosses highly inclined and distinctly bedded strata almost at right angles. In the drive on the lode westward at No. 6 level a band of black rock is found on both sides of the drive for some distance from the shaft. On one side of the lode white sandstone then makes its appearance, but the black still continues on the other side, and it is not till a further distance of 104 feet has been passed over that the white sandstone comes in on it, thus proving a throw of the beds of the country rock of that amount.

Mr. R. M. JOHNSTON expressed general approval with the criticism of Mr. Montgomery, and expressed regret that Mr. Power had not confined his attention to one of the many important subjects introduced and treated it in a more scientific manner.

MR. W. F. WARD, A.R.S.M., Government Analyst of Tasmania, said:—Mr. Power, in his notes on the Mount Lyell district, takes exception to the supposition that "many of the Tasmanian mountains are due to the shrinkage of the earth's crust," although he admits that "some slight puckering of the surface may be due to this cause." In so doing he joins issue with the great majority of geologists; for, as Geikie, in summarising the causes of upheaval and depression, says:—"With modifications, the main cause of terrestrial movements is still sought in secular cooling" (and consequent contraction). Confining our attention to the Tasmanian mountains, we may say that the highest peaks are one mile in height, the diameter of the earth 8,000 miles; the whole of this cannot therefore be called more than a "slight puckering," and it would on a 2ft. globe be represented by the thickness of thin foreign note paper. As regards the alleged inadequacy of the shrinkage to produce this comparatively slight effect, Mallet, the great authority on this branch of the subject, estimates that the *diameter* of the earth when liquid was at least 189 miles more than it is now; this implies also a shrinkage of the circumference to the extent of nearly 600 miles, so that we seem to have a very ample margin, sufficient to account not only for Tasmania's comparatively small hills, but for such enormous rock masses as the Himalayas and the Andes. Not satisfied apparently with this, however, Mr. Power invokes other agencies for the formation of mountains, and says:—

1. "The presence of the ocean is the greatest of these."

2. "We have not only the horizontal pressure of the ocean, but also the vertical pressure, and the force varies with the tides, this movement being more effective in shifting the earth's crust than a direct pressure."

3. "These ranges are like immense fossil waves rolling inland. They have a long slope on their western side, and a steep one on their eastern, just as if they had been pushed up by the sea."

The nearest approach to Mr. Power's suggestions which I have been able to find, is that of some American geologists, viz.:—"That the removal of rock by denudation from one area, and its accumulation in another affects the equilibrium of the earth's crust, and causes subsidence where deposition takes place, while the denuded area being relieved of weight rises;" this, however, has been fully met by proof that "should the removal and deposit of a few thousand feet of rock so seriously affect the equilibrium of the crust as to cause it to rise and sink in proportion, it would evince such a mobility in the earth as could not fail to manifest itself in a far more powerful way under the influence of lunar and solar attraction." If, then, the pressure of a few thousand feet of rock be incapable of raising the level of neighbouring districts to any appreciable extent, still less can the pressure of water, which has only about one-third the specific gravity of rock, be capable of slowly raising land, and sending it rolling inland "like immense fossil waves." If such were the case still greater would be the mobility and the influence of lunar and solar attraction. With regard to the Iron Blow I have found some difficulty in following Mr. Power's theory; but in view of the close neighbourhood of the iron pyrites and the hematite, of the fact that each is schistose in structure, that each contains much barytes, and that the hematite is on the footwall of the vein or deposit, I am still of the opinion expressed some time back in reply to Mr. Thureau: that the Iron Blow itself is the result of the decomposition of some of this large deposit of iron pyrites. I will only allude to the question of "fissure" veins to point out that Mr. Power quotes no authority against and suggests no substitute for "this fissure theory," as he terms it. In conclusion I can only agree with Mr. Montgomery that Mr. Power, notwithstanding his disclaimer, *has* drawn on his imagination for his theories.

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NOTES ON THE MOUNT LYELL DISTRICT, TASMANIA.

By Frederick Danvers Power, F.G.S.

In reply to my critics, I must say that I was rather surprised to find myself credited with being the author of new theories. It is possible that I am the first to apply the views expressed in my paper to Tasmanian geology, but I do not pretend to be the originator of what Mr. Stephens terms the "water pressure and wave theory," or of the anti-true-fissure-lode theory, although I am prepared to uphold them until disproved, or more suitable substitutes are brought forward. In writing my paper I took for granted that the researches of such men as Dr. W. B. Carpenter, F.R.S., and S. F. Emmons were known, and therefore considered it unnecessary to back up my opinions by quoting them and others, in the same way that it would be superfluous to quote Sir Isaac Newton when mentioning gravity.

My paper was intended to give but a sketch of the geology of the Mount Lyell district. To go into detail in the present state of the country would take months of residence on the spot. In making my views public I was aware from Tasmanian literature, as also by personal conversation, that they were in opposition to those generally accepted in the island, but by bringing the results of modern research to bear on local conditions, I had hoped to direct thought out of the groove into which it had fallen. Of course I did not expect to win those who had strong views on the subject over to my side at once, but I did expect them either to give valid arguments for their side of the question, or prove mine incorrect, especially when these sentiments are due to misconceptions on their part. Mr. R. M. Johnston, though expressing his strong opinion against my views, does not offer a single argument in favour of his, or against mine, unless his statement that most geologists have adopted the contraction theory to account for mountain formations can be considered one. In replying I am debarred from elaborating on my subject, as to give it full justice would require more time than can at present be spared. I must, therefore, be content with briefly vindicating my views. The two points on which we differ are:—

1. The main cause of mountain ranges.
2. The nature of most so-called true-fissure-lodes.

In the first place I do not consider that any one theory will account for all our mountain ranges. There are several labourers at work; but my contention is that the chief of these is the pressure of the ocean waters. The other agents are not ignored; due weight has been given to the contraction of the earth, rotation of our world, denudation, sedimentation, etc. Now, I do not for one moment suppose that as our earth cooled it possessed a smooth surface. Our knowledge of molten slags, both natural and artificial, tells us that there are several cooling centres, and these would at once set up currents, which, assisted by the evolution of gases, together with the lunar and solar attractions and the rotation of the earth, would form inequalities on the surface of the globe which served as the neuclei of our continents and oceans; the world would not then be universally covered with water, as I gather Mr. Stephens premises, for elementary elevations and depressions would be formed long before the earth was cool enough to allow water to condense on its surface. Our continental plateau once formed, and water made to occupy the basins, the pressure of that water immediately begins to act and increases as its quantity was augmented. At first, no doubt, the cooling of the crust would have a greater effect in raising land than the pressure of water. Volcanic action would also be a main feature, and the tendency of our rotating earth to throw bodies towards the east, which is made so obvious by our trains and steamboats at the present day, would have a greater effect on the cooling mass than on our more solid crust; but under the conditions then existing disintegration would be more rapid than at a later period, for the rocks would not be protected by vegetation to the extent that they were later on besides, violent storms, humid atmosphere, and the large quantity of carbonic acid in the air would soon work havoc among the hills, forming much sediment which would act on the comparatively thin crust in a somewhat similar manner to which the immense weight of the ocean does now.

Dr. W. B. Carpenter, C.B., F.R.S., in a paper read before the Royal Institution of Great Britain on 23rd January, 1880, entitled "Land and Sea considered in relation to Geological Time," says that the total volume of ocean water to that of land is as 36 to 1; that most land is in the northern hemisphere and most water in the southern; that the bed of the ocean is comparatively flat, not basin shaped; it descends suddenly from a comparatively shallow bottom to a very deep one; that we must distinguish between the real and ostensible borders of the ocean basin, an elevation of 100 fathoms would generally show the real continental platforms, and would join many islands to the mainland, while if the existing land was depressed to the same amount very extensive areas of what is now dry land would be overflowed by the sea; that the movements of elevation which have occurred from time to time in various parts of the land areas of the globe have been the result of forces acting in different directions—vertical and horizontal; that extensive platforms have been raised by the former, while the latter will throw it into plications of which the elevated portions will form mountain ranges. "Also, the largest mountain chains characterise the borders of the greatest oceans, showing that the lateral pressure from the direction of the oceans was approximately proportional to the extent of the oceanic basin."

Now, the reason I chose to illustrate my views by South American and Tasmanian mountains in preference to the Urals, as Mr. Montgomery would like, was because I preferred to write of places I have visited, and not depend on maps more than necessary. And here I would remark that during my several trips to Tasmania, which have extended north, south, east and west, I have been careful to note the general direction of the main ranges, often climbing to lofty summits in order to attain my ends. However, if Mr. Montgomery prefers to discuss the Urals I am willing, and would direct his attention to the immense tract of low-lying swampy ground forming the Siberian plain to the east of the Urals, and north of the Altai, Yablonoi, and Stannovoi Mountains; also to the inland seas (Caspian Sea and Sea of Aral) and the numerous lakes forming a chain all the way north to the Gulf of Obe. Does not all this remind us that this land has at some time been submerged by the ocean, and would not require much change in its level to be flooded again? We thus see that though the Ural mountains are now away inland, they were once a coastal range, as were the easterly and westerly mountains above mentioned, which also run parallel to their former sea coast.

Tides and currents also have their effect on mountain building, not only on account of the sedimentation which they assist, but also by their own mechanical force. Thus we find the currents of the Bay of Biscay strongest opposite the Pyrenees; where the currents impinge on the Californian coast we find the Sierra Nevada; large currents curl round on the Chilian coast, and there we have the Andes; while coming nearer home we have the main current sweeping along the east coast of Victoria, close to our Australian Alps. The enormous weight of water in our oceans—36 times the volume of land—also tends to press out any inequalities that form on its bottom, and drive them onward towards dry land, where they are relieved of their pressure. To take another homely illustration, as if one were to flatten out a portion of a sheet of paper which was bulged up in a confined place. In order to bring in a flippant remark about some "Jelly Theory," Mr. Montgomery goes out of his way to apply hydraulic data to solid matter! which proves that he does not understand the situation. A solid body like rock will, as we well know, yield to pressure to a certain extent, and while it is being bent up a considerable amount of friction is developed. If the active force is removed the raised land will not fall back into its original position, for although the weight of the accumulated rock may cause a slight sinking, still the weight is not sufficient to overcome the necessary friction that the greater force was able to do; not only this, but the rock when strained will give in places, so as to ease itself, thus obtaining a state of rest, although out of its original position. We therefore see that this is not a case of balancing a dead weight, but one of steady pressure, and that it is not necessary for the rock to be so mobile as to be affected to any great degree by solar or lunar influences, as Mr. Ward suggests. It is my aim to account for the plications which we see, and know to have taken place; not to prove the earth's crust mobile like a jelly, so that it can have its form changed *ad libitum* like a rubber ball. Assuming Mr. Mallet's calculation of the 600 miles excess of original circumference to be correct, it by no means follows that all this surplus land is heaped into mountains. There are other land surfaces to be accounted for besides these, but even if these 600 miles were heaped up into our present ranges, why should these almost invariably be near past or present sea coasts, and more or less parallel to them, unless the oceans had some great influence over their structure? Again, if due to contraction, it seems rather strange that some of our highest mountains should be built up of comparatively young rocks, which could not have been deposited when most of the earth's crumplings, due to contraction, were formed, *e.g.*, the Alps, in speaking of which Professor Archibald Geikie in his text book, p. 918, writes:—"It is strange to reflect that the enduring materials out of which so many of the mountains, cliffs, and pinnacles of the Alps have been formed are of no higher geological antiquity than the London clay and other soft Eocene deposits of the South of England." I have been accused of advocating new theories contrary to well-known principles. What I have really done is to make use of nature's laws to account for observed phenomena, and not to invoke miracles to my aid. These laws of nature are in force now, and can be seen at work any day. It is no use for us to try and ignore them, for they will exist whether we like it or not.

To return to our local subject. If the ocean has not been the chief cause of the range which includes Mounts Lyell and Owen, how do my opponents account for its parallelism to the sea coast, and its steep slopes away from the sea; and why have the mountains that dragged out appearance and broken surface? Will not the phenomena observed be accounted for equally as well, if not better, by the views I have expressed than by the simple contraction theory? The pressure of water on the bottom and sides of a vessel containing it is well known; the force of the tides and currents is also appreciated. The effect of the rotation of the earth tending to throw objects towards the east is felt by our express trains and ocean boats, as is also that of winds; the shape of waves of water or sand is familiar as having the steeper side away from the force producing them; where, then, is the absurdity of accrediting the ocean with being the greatest auxiliary to the contraction of the earth in mountain building? Mounts Lyell and Owen show no signs of having been caused by simple denudation; there is no indication of there ever having been sufficient water to cut out the Linda Valley. The conglomerate capping this range was deposited before the mountains were raised, and most of the gravel in the Linda Valley is due to the weathering of the conglomerate, which was cracked and broken as the peaks raised their heads at the expense of the surrounding neighbourhood, for an inclined surface has a greater superficial area than a horizontal one.

Concerning the so-called fissure lodes, I consider the term as generally used misapplied. In our text books we find the fissure theory upheld. My old professor at the Clausthal School of Mines, Herr Dr. Bergrath v. Groddeek, states in his work on Lagerstättenlehre, "Gänge sind ausgefüllte Spalten." V. Cotta in his book writes:—"Since, according to our definition, all true lodes are aggregates of mineral matter in fissures, fissures must necessarily have first been formed and then filled. Both operations may have been independent of each other, and even when this is probably not the case still the formation of the fissure was an entirely different operation from that of their being filled with mineral matter."

Without disparaging text books, from which we learn the A B C of sciences, we really get more information from original articles and discussions on the same by men who have made researches from all points of view. Thus Mr. S. F. Emmons, one of the ablest living authorities on ore deposits, states that:—"Many deposits formerly supposed to have been deposited in open cavities have really been formed by metasomatic interchange of ore with country rock, *e.g.*, lead ore in limestone formations, Leadville, U.S.A. Very many so-called fissure veins in crystalline rocks are formed by percolation water circulating along joints and shrinkage cracks, fault planes or zones of crushed rock, which have filled the interstitial spaces and replaced the materials of the adjoining country rocks to a greater or less extent by the materials they held in solution, but are not the filling of any considerable open cavities." Mr. Richard Pearce in 1869 noted that the gangue material of the veins of Cornwall was the more or less completely altered country rock, and not foreign material brought from a distance.

Now, rocks may be so strained that faults result, but it is seldom that these faults leave open cavities that warrant the term fissure; for what would otherwise be a fissure is occupied by broken rock at the time of their formation. They are, therefore, not "true fissure lodes," such as may be seen in process of formation at the Steamboat Springs in Western Nevada, but fault lodes pure and simple, which show a brecciated structure, flucan, partings, slickensides, etc., all indicative of motion, and that usually gradual and under great pressure.

My idea of the genesis of the "Iron Blow" was that the hematite was segregated first in a layer of schist favourable for it; that after the peaks of Mts. Lyell and Owen were elevated they sank slightly, when the saddle connecting them was strained; the hematite being hard and strong was enabled to resist this force better than the weaker rock to its west, which, being loosened, located the site for the pyrites deposit. There is nothing peculiar in both the hematite and pyrites containing baryta, since they both, in my opinion, obtained their mineral from the same source, but there is no trace of any intimate connection between these two deposits, as there is a sharp line at their junction, and where we do find the pyrites decomposed it is converted into a gossan or hydrated oxide of iron, not hematite. Although the hematite deposit was not easily ruptured when pressed end on, yet the lateral thrust from the direction of the coast caused strike faults in it, as indicated by the soft rubbed-up portions where one part has slid over another.

Before condemning this opinion in an offhand manner, one should carefully weigh the pros and cons, utilising such knowledge as is possessed to enable a fair judgment to be arrived at. It is not very scientific to rest content with hypotheses because they happen to be generally accepted; we should be active in searching out the truth, and by upsetting one theory we advance one step nearer our goal, so that by opening the above questions fresh points should be gained, either by ridding ourselves of unnecessary theories or by adding fresh facts to our stock of knowledge.

TOTAL ECLIPSE OF THE MOON, 24TH MAY, 1891.

OBSERVED AT LAUNCESTON; LAT. S. 41DEG. 26MIN. 01SEC.; LONG. E. 9HRS. 48MIN. 31SEC.

BY A. B. BIGGS.

The computed times for this eclipse (disregarding the penumbra) were:—

		hrs.	min.	
First contact with shadow	...	2	29·8	A.M
Beginning of total phase	...	3	38·2	„
End of „ „ ...	...	4	57·2	„
Last contact with shadow	...	6	5·6	„

(All local mean time.)

Unfortunately, although I had made arrangements for watching all through the duration of the eclipse, my hopes were doomed to disappointment in regard to a satisfactory view of the event. On turning out I found the whole sky overcast with clouds, the moon just peeping out now and then between the thick clouds, but always veiled more or less with haze. So transient were the views that it was some time before I could adjust the telescope to focus. Having missed the first contact with shadow, I hoped to get the beginning of total phase, but it was not until 4hrs. 0min., or 2½min. after totality had commenced, that I could get a view. There was at this time, however, a bright rim on the eastern edge of the moon, apparently scarcely obscured, the moon appearing through the thin clouds like the young crescent. Again at 4hrs. 40min., or 17½min. before the end of totality, the crescent showed itself through the haze, but shifted to the other or preceding edge. At no time during totality was the darkness at all comparable with that of a cloudy, moonless night. It was evident that even in the midst of the cone of the earth's shadow some considerable amount of the sun's light reached the moon's surface. This, of course, can only be accounted for by the refraction of the earth's atmosphere.

The moon sank out of view behind the hills with the penumbral shade conspicuous upon her western rim.

The principal points which I set out to observe, namely, the actual moments of contact, the progress of the edge of the shadow over known points of the moon's surface, the tint, the amount of darkening, etc., were almost wholly missed. No definite estimate could be made as to the tint, veiled as the moon's face was more or less all through, but no trace of coppery tint was observable, only a dark, slaty gray.

(I have since learned that in other localities favoured with a clear sky the coppery tint was conspicuous. I can only account for my missing it by its being disguised by the persistent haze.)

The following extract from *Knowledge* of 5th June, 1885, may be of some interest by way of comparison with the foregoing notes. After referring to my report of the almost total eclipse of the moon on 30th March preceding, as given in the *Launceston Examiner*, which is quoted, the editor remarks :—

"The points of interest to be noted are the opacity and slaty tint of the earth's shadow, utterly obliterating all detail on that part of the moon's surface which it covered, and the entire absence of that copper-colour which had become so familiar to observers as to be regarded by them as almost the normal hue of the earth's shadow. Now it is noteworthy that this red tint was conspicuous by its absence on the occasion of the eclipse of the moon on October 4 last, whence it would seem that the terrestrial atmospheric conditions then existing must still persist."

I was favoured by a clear sky on that occasion.

THE TRANSIT OF MERCURY, MAY 10, 1891.

Observations taken at Private Observatory, Launceston.

By A. B. Biggs.

The morning of the 10th set in with a dense fog, hiding the sun from view. However, a few minutes before the expected entrance of the planet upon the sun's face (which was set down as 9h. 42min. 15sec. local mean time), the fog partially broke, giving promise of a clear view of the transit, a promise which was by no means fulfilled. A haze again covered the sun just before the critical moment, but a careful watch was kept on that part of the sun's limb where the planet was to enter. At 9h. 43min. 56sec. a partial clearing allowed a decided notch to be seen on the sun's edge. Of course the actual contact must have taken place somewhat earlier. The internal contact, so far as could be judged, occurred at 9h. 45min. 58sec. At 9h. 51min. 17sec. the planet was estimated to be one diameter within the sun's limb. During this time a local cloud condensation was taking place which almost prevented further observation, allowing, however, an occasional glimpse between the clouds, but through a haze at best. The alternate partial brightening and overshadowing was exceedingly baffling, and as a consequence the programme which I had laid out was seriously interfered with, besides necessitating a frequent changing of the apparatus to suit the varying conditions. About noon I found the speculum so bedewed that I could not see my face in it, and I had to take it out and warm it at a neighbour's fire. I feared at first that the silver film was destroyed, as the moisture appeared to have got underneath it. However, after a careful warming it came all right, and I had no further trouble with it.

There was a clear, well-defined spot on the sun's southern hemisphere, not large, about half a minute in diameter as nearly as I could estimate, including penumbra. Between this and the planet I managed to get a few chance micrometer measures, during the intervals of comparative brightness. Whilst engaged in this a *bright spot* on the centre of the planet's disc caught my attention, apparently as if the sun were shining through a hole in the planet. A similar appearance has been noted by some observers of previous transits, but the thing seems so unaccountable and improbable that it has been attributed to optical illusion. However, I could have no doubt of its reality on this occasion. The following note is from Chambers's Astromony :—"The annulus round Mercury and the *White Spot* on Mercury during transits across the sun may now be regarded as regular concomitants of the phenomenon; but there is no agreement amongst astronomers as to the cause of these appearances. The *White Spot* has been regarded by some as indicative of volcanic action, but this seems mere fancy. Prof. Powell, with more show of reason, suggested that diffraction of light had something to do with the matter. . . . . Huggins rejects this theory. It might conceivably have its origin in the internal reflection of light in a Huygenian eye-piece." (I was using a Ramsden or *positive* eye-piece). Webbe, in his "Celestial Objects," says that it "arises probably from deception from the violent contrast and the fatigue of the eye. . . . No terrestrial analogy will explain a luminosity thus visible close to the splendour of the Sun, and it seems natural to refer it to the exhausted state of the retina" (The haze on this occasion precluded the operation both of "violent contrast and fatigue.") A possible explanation may, perhaps, be found in connection with the *atmosphere* of Mercury. The "annulus," which is usually seen around Mercury during transits, would seem to indicate the existence of an atmosphere of considerable extent. (I failed to see it on this occasion, though, I believe, so far as I can recollect, that I saw it during a former transit; but unfortunately I took no notes at that time. The haze, however, would sufficiently account for my not seeing it this time.) This body of atmosphere would act somewhat as a lens (or rather as a "spot lens") and would form a diffuse focus or image of the sun on this side the planet. We should not under ordinary circumstances see this image, because the rays would cross and pass by on each side of us, unless there were some sort of translucent *screen* on which to receive it. Such a screen might possibly consist of the meteoric matter which is supposed, or I may say is known to exist in interplanetary space, some of which reaches us in meteoric showers, and some probably mere planetary dust, occasioning the phenomenon known as the "Zodiacal Light." (Of course every particle of this would be moving in some regular orbit, in accordance with gravitation law.) This may be deemed a very fanciful theory, and possibly may excite ridicule from mature scientists; but slow progress will be made in scientific knowledge if it is to be impeded by such a fear. I have not overlooked the fact that the outer or upper stratum of Mercury's supposed atmosphere would be more rarefied and less refractive than the lower; in fact it would be unequally refractive throughout; but this, I think, would be rather in favour of the theory, inasmuch as it would lengthen the focus and bring it nearer to us.

The contacts were observed as follows:—

LAUNCESTON MEAN TIME, MAY 10.	AT INGRESS.
hrs. min. sec.	
9 46 56·3	Sun's limb notched. Actual contact earlier.
9 45 58	2nd or internal contact, apparent geometrical, but no appearance of solar light outside the planet.
9 47 52	In clear of sun's limb.
9 51 17	About 1 diameter clear of limb.
P.M.	**AT EGRESS.**
hrs. min. sec.	
2 31 38·25	About 1 diameter from sun's limb.
2 35 10·3	Apparent geometrical internal contact, slight ligature (?)
2 36 41·7	Apparently bisected.
2 38 40·7	Clear from sun's limb.

MICROMETER MEASURES

BETWEEN MERCURY AND SUN-SPOT.

(Mercury South. Preceding.)

Local Mean Time.	Edge of		Difference Dec.	Mer. Pre.
	Mer.	Spot.		
hrs. min. sec.			′ ″	sec.
0 49 8·4	N.	N.	7 27	—
0 54 38·5	N.	N.	7 40	5½
1 43 26	Centre	Centre	8 52·3	17
1 43 43	Pre.	Pre.	—	18½
1 53 20	Centre	Centre	—	19½
1 53 39·5	S.	N.	9 35·2	—
1 58 4	N.	Sun's S. limb.	1 14·6.	—

The above were all the measures I had opportunity for obtaining. The chronometer readings are carefully corrected for error and rate. Mr. Sparrow, of Launceston, kindly assisted me by reading the chronometer.

OBSERVATIONS ON THE CAUSES OF ELEVATION AND SUBSIDENCE OF THE EARTH'S CRUST.

By R. M. Johnston, F.L.S.

Any enquiry into the causes which have produced, and are still producing, mountains and mountain chains cannot be satisfactorily carried out apart from the study of the causes which originally produced the grand irregularities of surface, which primarily determined the original areas of continents and oceans.

In offering any opinion of my own upon the merits or defects of the rival hypotheses assumed by so many eminent physicists to account for elevation and subsidence, I hope it will be conceded that I do so with much diffidence; for where so many eminent men fail to be satisfied with each other's views on a subject which necessarily rest so largely on arbitrary values for unknown data, it is obvious that any view which I may tend to favour must in my own mind be attended with a large measure of doubt, and on some obscure points my judgment may be suspended entirely. As a novel theory, however, has recently been referred to by Mr. F. Danvers-Power, relating to the elevation of mountain chains, it may be of some interest at this time to enter more fully into the consideration of those hypotheses of causation which have gained the most favour among physicists and geologists. Of course the correct observation of effects and the true interpretation of immediate or primary causes are very different things. The geologist, as such, is entitled to speak with authority as regards the former, but undoubtedly the correct interpretation of causation is more purely within that realm of science where the physicist, as such, has the greater claim to be heard. The geologist may best know what are the magnitude and characteristics of certain obvious changes in a given region, but his interpretation of the cause or causes at work—not so open to observation—may be liable to errors from which the knowledge of the physicist might have saved him. The apparent cause to the geologist may, to the mind of the skilled physicist, be altogether objectionable when tested by his more exact methods for determining its nature and efficiency. With some the mere parallelism of certain phenomenal features—great ocean boundaries and certain mountain chains—often appear to stand as cause and effect. This may be so; but is it true? The answer to this query will be given hereafter. As it is desirable before discussing any one view to summarise briefly the principal hypotheses which have gained the greatest acceptance among scientific observers generally. The evidences for the vast extent of movements of elevation and subsidence, past and present, are so well established that I need only confine my attention to the leading theories concerned in their causation.

FORMATION OF CONTINENTAL AREAS AND OCEAN BASINS.

Assuming that at first the earth was a heated sphere around which the existing waters of ocean seas and rivers were gathered in the form of a gaseous envelope, we are led to conclude that the radiation of heat, immediately prior to the cooling and consequent condensation of water vapours, would gradually tend to form a solid crust. The question of importance at this stage is: Was the surface matter homogeneous and smooth immediately before and after it hardened into a crust, or was it heterogeneous, containing irregularities of surface? If the former, we could not imagine how the condition for determining continental areas and oceanic basins could be initiated. We are therefore led to accept the alternative hypotheses as more in accord with known facts. But the root matter here contemplated involves the conclusion that prior to the cooling and condensation of the gaseous vapours, which eventually occupied the primæval ocean basins, the forces of themselves then at work were equal to the task of producing irregularities on the earth's surface, whether by contraction expansion, or transfer, sufficiently grand in scale to form more or less elevated continental areas in the midst of basins grand enough to receive the oceanic waters. There may not have been at this stage either deep abyssal regions on the one hand nor high mountain peaks on the other, but it is almost certain that forces then at work sufficed to produce such relative elevation and depression, as are now supposed by many to be only rendered possible by changes in the loaded surface caused by the transfer of superficial solid matter mainly through aqueous agencies. A diversified distribution of the surface magma is assumed with good reason by Mallet, J. D. Dana, Prof. Hennessy, Archdeacon Pratt, Geikie, and many other eminent physicists and geologists, as a primary condition; and this primary condition, owing to the unequal rates of cooling, and differences of density of different masses of magma, is assumed to be the initial factor in producing elevated and depressed surfaces. Dana in his last work ("Manual of Geology," 3rd edition, 1879) states:—" The fact that the continental and oceanic areas were determined in the first cooling of the globe signifies that in the cooling or the radiation of heat into space there were areas of greatest and least contraction. This difference in cooling and the resulting level of the surface must have been owing to some difference of quality or condition in the material." One quality has been brought to light by pendulum experiments in India, proving that gravity is greater at the coast stations than at the continental stations, and greater at the island stations than at the coast stations. In harmony with these observations are the opinions advanced by Archdeacon Pratt (The Figure of the Earth, 1860 ; on the Constitution of the Solid Crust of the Earth, *Nature*, 1871) who first attributed the origin of oceanic depressions and continents, and also of mountain chains, to unequal contraction in a cooling globe, but in the last refers the formation of mountains to lateral pressure, and there concludes " That the crust beneath the ocean is of greater density than the average portions of the surface—that is, where the contraction was greatest the density of the rich material below is greatest and proportionately so." Mr. George H. Darwin, in investigating the bodily tides of viscous spheroids (Phil. Trans., 1879), among other important matter also points out that under the combined influence of rotation and the moon's attraction the polar regions tend to outstrip the equator, and to acquire a consequent and slow screwing motion from east to west; and Dr. Geikie, who has certain objections to offer, admits in respect of Darwin's theory, that it is conceivable in earlier conditions of the planet, that this screwing motion may have had some influence in determining the surface features of the planet. In a body not perfectly homogeneous it might originate wrinkles at the surface running perpendicular to the direction of greatest pressure. "According to this theory the highest elevations should be equatorial, and should have a general north and south bend, while in the northern hemisphere the main direction of the masses of land should bend round towards the north-east, and in the opposite hemisphere towards the south-east." While there are many difficulties standing in the way of the full acceptance of Mr. Darwin's theory, Dr. Geikie still thinks " It is well worth consideration whether the cause suggested by Mr. Darwin may not have given their *initial trend* to the masses of land, *so that any subsequent wrinkling of the terrestrial surface due to any other cause would be apt to take place along the original lines.*" I might also add that to such influence in some measure might be still ascribed those remarkable lines of weakness in both hemispheres, which mark the course of volcanic action, and which, in a large measure, *may determine the curves of certain coastal mountain chains.* Apart, however, from the universality or antiquity of alleged causes advanced as the principal factors in mountain making (I here use the word mountain-making in preference to mountain-building, for the latter term is more appropriately restricted to peaks and cones built up by volcanic agency), it must be confessed that whatever mountain chains were formed in the earliest geological periods they have been largely obliterated in later times. This is becoming more evident as geological observation extends; for it is now well established that in Asia, South America, North America, and in Europe, the great era of mountain making was during the Tertiary period, and even in Australasia it is probable that its principal Alpine ranges were inconspicuous ridges during the early part of the Mesozoic period. Still the intensity and universality of the elevations then produced demand a corresponding universality of cause, or causes. A considerable number of hypotheses at different times have been proposed by eminent investigators, all of which commend themselves in some particulars, but all of which, taken separately, involve difficulties which at present appear to be insurmountable. Perhaps the truth lies in several, and, *at least*, does not demand the rejection of one cause because another seems to answer all the conditions when confined to a particular case. It appears to me, however, that there is one which may be well considered as the governing or mother cause to two or three of the rival hypothetical causes; the latter being consequents standing in the relation of child to parent rather than absolutely independent causes. The parent cause, in my opinion, appears to be the Contraction Theory so intimately associated latterly with the name of Robert Mallet.

CONTRACTION THEORY.

If our planet has been steadily losing heat by radiation into space a corresponding diminution in its volume must also be looked for; for cooling is implied in contraction. A succinct account of the effects which Mr. Robert Mallet demonstrated might be expected from the secular cooling of our globe is given as follows by Dr. Geikie:—"According to Mallet the diameter of the earth is less by 189 miles since the time when the planet was a mass of liquid. But the contraction has not manifested itself uniformly over the whole surface of the planet. The crust varies much in structure, in thermal resistance, and in the position of its isogeothermal lines. As the hotter nucleus contracts more rapidly by cooling than the cooled and hardened crust the latter must sink down by its own weight, and in so doing requires to accommodate itself to a continually diminishing diameter. The descent of the crust gives rise to enormous tangential pressures. The rocks are crushed, crumpled, and broken in many places. Subsidence must have been the general rule, but every subsidence would, doubtless, be accompanied with upheavals of a more limited kind. The direction of these upheaved tracts, whether determined, as Mr. Darwin suggests, by the effects of internal distortion or by some original features in the structure of the crust, would be apt to be linear. The lines, once taken as lines of weakness or relief from the immense strain, would probably be made use of again and again at successive paroxysms or more tranquil periods of contraction. Mr. Mallet has ingeniously connected these movements with the linear direction of mountain chains, volcanic vents, and earthquake shocks. If the initial trend to the land masses were given as hypothetically stated by Mr. Darwin we may conceive that after the outer parts of the globe had attained a considerable rigidity, and could then be only slightly influnced by internal distortion, the effects of continued secular action would be seen in the intermittent subsidence of oceanic basins already existing, and in the successive crumpling and elevation of the intervening stiffened ridges." To overcome the difficulties which arise out of one or other of these hypotheses various modifications of the contraction theory have been generally adopted, the greater number still adhering to the view that the *main cause* of terrestrial movements must be sought in secular contraction. The theory which seems to be most favoured next in importance to the Contraction Theory is:—

> The alleged expansion and contraction of the underlayers resulting from a rise or fall of temperature caused by the loading or unloading of the areas affected.

Great uncertainty still exists as regards the present condition of the earth's interior; some conceiving it to have a fluid or viscous central core; some again incline to the view that a viscous intermediate layer separates the solid crust from the solid nucleus; while others have given reasons for the view that on the whole it has now attained a rigidity equal to that of glass or steel.

EXPANSION AND CONTRACTION OF THE UNDERLAYERS RESULTING FROM A RISE OR FALL OF TEMPERATURE.

Babbage seems to have been the first to suggest this theory. In his memoir (1834) on the Temple of Serapis, "Besides recognising the relations of isothermal planes, and the effect upon them by the surface changes, whether removals of rock material, or accumulation, the memoir accounts for changes of level caused through the expansion or contraction caused by changes in the subterranean heat or in the position of these isogeothermal planes." Mr. Mellard Reade has lately, "Origin of Mountain Ranges," strongly insisted on this factor as an important if not the main factor in producing subsidence and elevation. Similar views have also been strongly advocated by some of the American geologists who have explored the western territories of America. These have pointed "in proof of its truth to evidence of continuous subsidence in tracts where there was prolonged deposition and of the uprise and curvature of originally horizontal strata over mountain ranges like the Uintah Mountains in Wyoming and Utah, which have for a long time been out of water." Dr. Geikie, in commenting upon this theory, admits that in so far as the internal structure of rocks may be modified by such progressive increase of temperature as would arise from superficial deposit, the cause of change must have a place in geological dynamics, but he cannot allow that the removal and deposit of a few thousand feet of rock should exert such an influence as to affect the equilibrium of the crust; for to admit this, "would evince such mobility in the earth as could not fail to manifest itself in a far more powerful way under lunar and solar attraction." He, however, goes on to say "that there has always been the closest relation between upheaval and denudation on the one hand and subsidence and deposition on the other, is undoubtedly true." But he adds the significant words that "denudation *has been one of the consequences* of upheaval, and deposition has only been kept up by continual subsidence." Certain questions bearing upon the permanence of continental areas and great oceanic basins are involved to a great extent in the views under discussion, and may have led to the adoption of restricted views as to fundamental laws of causation.

Prof. C. Loyd Morgan in a recent article on elevation and subsidence (Geol. Mag., July 1888) in criticising the views of Mr. Mellard Reade and others as regards the effects alleged to arise out of the transfer of sediments suggests other ways in which the loading and unloading of the earth's crust may indirectly bring about subsidence and elevation, and at the same time ingeniously advances reasons in favour of the existence of an underlying liquid or viscous substratum. Accordingly, without committing himself to the acceptance of the theory held by those who attribute subsidence to mere weight he suggests to the upholders of that theory that the added weight of the sediment above would entail on this hypothesis an added weight below—that is if we suppose that the solidified rock adheres to the lower surface of the crust region. In a region undergoing denudation, on the other hand, the lightening of the load would entail the melting of some of the solidified or crystallised magma, assuming with Mr. Mellard Reade and Mr. Davison, that owing to the cooling and contraction of the earth's crust there is at some depth beneath the surface a level of no stress, where there is neither lateral compression nor extension, though the rocks are subject to the vertical pressure of the overload. He then suggests that throughout the zone of maximum tension due to circumferential contraction the rocks may be rendered fluid by relief of pressure. Such melting, he adds, would be accompanied by expansion manifesting itself at the surface by an uplift. By the expansion of the melting underlayers tensile stress in the overlying strata would be called into play, and this would throw those strata into a state of tensile strain, thus giving origin to normal faults to the gradual gaping of mineral veins and dykes, into which the molten matter would be injected by the expansive force. Without denying, therefore, the influence of secular refrigeration, he suggests that we have on this hypothesis an efficient primary cause of volcanic eruptions. Commenting upon the differences of opinion as to the level of the stress he points out that according to Mr. Davison it lies five miles deep; according to Mr. Mellard Reade it is taken at one mile; while Mr. O. Fisher would reduce it to less than a mile; and accordingly Prof. Morgan urges caution as to the use of precise imposing mathematical calculations based upon arbitrarily selected data where it concerns problems "concerning which the most noteworthy feature is our profound ignorance."

MR. DANVERS-POWER'S REFERENCE TO THE SUPPOSED INFLUENCE OF THE PRESSURE OF OCEAN WATERS UPON THE FORMATION OF PARALLEL MOUNTAIN CHAINS.

In regard to this hypothesis I must confess that to me it seems to be a most extraordinary one. Mr. Danvers-Power does not give us the slightest indication to help us to conceive how, of all agencies that may be concerned in the dynamics of mountain making, "the presence of the ocean is the greatest." It is hardly necessary to remind us how great is the influence of water in the work of denudation, and in the redistribution of wasted rock sediments over lower levels of sea and land; but how the gravity or even surface movements of ocean waters extending over wide ocean areas can concentrate their force of gravity or pressure laterally by thrust upon the margins of continents is a nice puzzle to any physicist. Surely it must have occurred to Mr. Power that the vertical radii of a column of rock is from 2½ to 3.4 times the specific gravity of an equal column of water; that the radii of a continental area are much greater than the radii over the more depressed ocean areas, capped as they are with the light element water; that the pressure of a fluid upon any of its limiting surfaces is altogether independent of its quantity (known as the *hydrostatic paradox)*; that is—the total pressure of water, (still) against and perpendicular to any surface is equal to the weight of a uniform column of water, the area of whose cross-section parallel to its base is everywhere equal to the area of the surface pressed; and whose height is equal to the *vertical* depth of the *centre* of gravity of the surface pressed below the surface of the water. It is a natural mistake among young students of hydrostatics to fall into the error that the magnitude of the horizontal expanse of any body of water intensifies the pressure upon its limiting surfaces; but the determining factors of pressure given hereinbefore shows that the horizontal pressure upon the vertical face of any wall or embankment, say 100 feet deep and 100 feet wide, would just be the same if the width were extended 1,000 miles or to any conceivable extent *so long as the area pressed* and the vertical depth of its centre of gravity below the level surface remain unchanged. That Mr. Danvers-Power has fallen into this elementary error as regards the lateral pressure of oceanic water is beyond doubt, for there is no escape on the plea of misconception or ambiguity in the following statement intended by him to show that greatness of *expanse* or area of ocean intensifies lateral pressure upon coast lines. Thus in accounting for the parallelism of high chains of mountains with great ocean basins, he states—"We almost invariably find that the highest mountain ranges have been developed more or less parallel to the past or present sea coasts that are washed by the largest bodies of water. Thus, in South America, we find the Andes on the west higher than the mountains of the east coast; also that the western shores of America are washed by the Pacific Ocean, which is greater in area and depth than the Atlantic. Coming nearer home for an example we find the highest Australian Mountains on the East Coast, the Pacific again being larger than the Indian Ocean. In Tasmania, however, matters are somewhat different, for there is an unbroken stretch of water from its West Coast to South America; while on its East Coast some twenty degrees distant *New Zealand acts as a breakwater*, and braces up the ocean so to speak, relieving the East Coast of Tasmania of much pressure from the main body of water;" and further on he again states:—"We not only have the horizontal pressure *of the ocean*, but also the vertical pressure." In his reference to Tasmania he is extremely unfortunate, for there is nothing more probable than that Tasmania, as *a whole*, forms but a southern prolongation of the Eastern Alps of Australia, and the causes which led to the original determination of the main chain operated in the formation of its southern extremity. And again he does not recognise the fact that the highest Alps of the Australasian region run along the *Western Coast* of New Zealand in a line north easterly and parallel to the south eastern coast of the mainland of Australia, and are not found on the eastern border, which is washed by the full sweep of the South Pacific Ocean, to whose influence he ascribes the smaller Alps of the Eastern border of the mainland of

Australia. But apart from such consideration it is clear from his observations that he regards the largeness of the *ocean area* as a factor in intensifying the horizontal pressure of its waters, and thus runs counter to one of the elementary laws determining the horizontal pressure of fluids. When we consider this limitation we can perceive how insignificant must be the influence of lateral pressure of ocean waters upon coast lines when compared with the enormous force required to bulge the solid earth into mountain chains. Again, as regards the energy of water set in motion by winds, and the currents induced by lunar and solar action, it is clear that the amount and direction of such forces do not harmonise so closely with the direction of the lateral thrusts, which have produced those remarkable chains of mountains like the Andes, that their influence *should be added* to the supposed influence of the pressure of oceanic waters already referred to. As regards the reference to Dr. Carpenter I cannot see that the quotations given have any bearing upon the pressure exerted by oceanic *waters* on their land border. Indeed, Mr. Danvers-Power does not seem to be aware that the last quotation referred by him to Dr. Carpenter is nearly exactly word for word identical with, and, no doubt, adopted from Dana's theory of the elevation of mountain chains parallel to the great oceans. (Dana in p. 828, Manual of Geology, 3rd edition, 1879). Dana here affirms (prior to Dr. Carpenter), "The fact that the largest and loftiest mountain chains, greatest volcanoes, and other results of uplifting and disrupting force characterise the borders of the largest oceans, shows that the shoving *action from the direction* of the oceans was approximately proportional to the ocean *basins*; but Dana clearly explains that this shoving motion is not due to the superficial waters contained in these basins, but that " the landward action of the force seems to be a necessary consequence of the fact that the *crust* over the oceanic areas was, and is abruptly *depressed below* the level of the continental, so that the lateral pressure from its direction would have *the advantage of leverage beneath the continental crust*, or rather would have acted *obliquely* upward against it." There is a fundamental difference here between the lateral pressure of ocean water, and the oblique upward lateral thrust of the ocean bed, and Dr. Carpenter's quotation is in entire harmony with Dana's theory, and gives no support to Mr. Danvers-Power's *ocean water theory.* The idea originated by Archdeacon Pratt that the rocky material under the ocean is more dense than that under continents has also influenced Dana in ascribing greater stiffness or rigidity to oceanic areas, and so determining in some measure the peculiarities connected with mountain chains running parallel to the great ocean. At any rate their arguments in no way support the novel theory of Mr. Danvers-Power. As regards the parallelism observed between oceans and mountain chains, I have only to observe that such parallelism need not be interpreted as cause and effect. Although, if we assume original flexures on Darwin's theory, trending in the present direction of these chains it is certain that if the continental areas so sculptured were slowly submerged in the direction of the great ocean areas, that the basal contour lines of height would certainly form the barriers to the ocean basins, and these of necessity would produce the parallelism referred to—*i.e.*, the downward sinking of the land would better explain the parallelism observed than the reference to pressure from the direction of the ocean, whether from its bed or its superficial waters. I think, therefore, that good reasons have been given for rejecting the theory put forward by Mr Danvers-Power.

A NOTE ON THE ARITHMOMETER AS AN AID TO ACTUARIAL WORK.

By F. J. Jacobs, A.I.A.

The arithmometer is peculiarly adapted for working out the chief details of a classified valuation of a life assurance office. The process is a simple one, being merely a series of multiplications, and the work can be carried out very rapidly by an ordinary computer. The results worked out and set down by one computer can be checked and verified by a second computer using a different machine, while any errors in the original work may be investigated by a third worker, using a third machine. By this means complete accuracy is ensured, and the use of the different machines avoids any possibility of error should either of them happen to fall out of order and become liable to repeat its own mistakes.

Several able expositions of the uses of the arithmometer have been published, and amongst them may be cited papers by Major-General Hannyngton and Mr. Peter Gray in the 16th and 17th volumes respectively of the *Journal of the Institute of Actuaries*. At the beginning of his paper Mr. Gray remarks :—" It is usual to describe the arithmometer as a machine which enables a person, however unskilled himself, to perform the operations of multiplication and division with facility, rapidity, and unfailing accuracy. This, as a description, is correct as far as it goes, but as an enumeration of the properties of the machine it is inadequate and defective. It entirely omits that property which forms its special adaptation to our purpose, and in default of which its utility would be comparatively limited. Besides the facilitation of the operations named the machine will also in forming the product of two given numbers either add that product to or subtract it from another given number according to the pleasure of the operator." Mr. Gray then proceeds to give illustrations of the adaptability of the machine for the construction of tables, and amongst the acturial problems he investigates are :—

1. To form a table of assurances from a corresponding table of annuities.
2. To construct a table of policy values from a given table of annuities.
3. To construct commutation columns from any given mortality table.

Amongst modern tables constructed by the calculating machine must be mentioned those computed by Mr. David Carment, F.I.A. A copy of the work is submitted for inspection. These tables show the value at the end of any number of years of an endowment assurance for £100, payable at different ages and under different rates of interest, according to the "Institute of Actuaries H.M. Tables of Mortality." In constructing these tables Mr. Carment utilised a modification of Gray's continuous method, and, speaking briefly, the work consisted in placing upon the machine a constant (the reciprocal of a certain function) and multiplying this by the successive differences of another function, the results being, of course, taken down after each operation. The process of the work is lucidly explained by Mr. Carment in the preface to his tables. It must be noted that the multiplication referred to is performed continuously, and that each step is performed *without* erasing the result attained by the preceding operation. The correctness of each column of results is proved by a very simple calculation. The whole of the tables were calculated by means of the arithmometer, with the exception of a small portion at the end, which. owing to the partial breakdown of the author's machine, were done by another process; the book is an interesting example of the work that can be performed by the calculating machine.

I have frequently had occasion to use the arithmometer in the computation of different results, and have found it a most correct and expeditious means of performing work that might, under ordinary circumstances require a tedious mental application. The arithmometer now exhibited by Mr. Johnston is, as he has stated, of the latest pattern, and combines the original model with a stability and perfection of construction that should reduce to a minimum the possibility of errors arising from imperfect or impaired machinery.

HYPNOTISM AND ALLIED PHENOMENA.

By Walter Spencer, M.D., M.R.C.S., Etc.

In judging newly observed phenomena for the purpose of reconnoitering the field for further exploration it is not easy to steer a medium course between the caution which demands too much and the receptivity which is satisfied with too little investigation. The former borders upon obstructiveness, the latter merges into credulity. In the first part of this paper I shall state ascertained facts, after which I shall have to lay bare the dilemma between necessary caution and regrettable credulity.

In 1843 Dr. James Braid, of Manchester, found that he was able in certain patients to induce an artificial sleep, accompanied by insensibility to pain. He made use of the power more for the relief of pre-existing pain than as a help in surgery, but under his auspices the eminent dentist, Sir J. Tomes, was surprised to find that he could extract several teeth without his patients having any consciousness of the operation. Dr. Braid used to rivet the attention and eyes of the patient upon something shining placed close at hand so that it was a strain to look at. He considered that fatigue of the ocular muscles was a chief factor in inducing the required condition. The new process was christened Braidism, but was not adopted to any extent in England, the triumph of the easy anæsthetics, chloroform and ether, seeming to render its practice unnecessary. In France, however, two great schools devoted to the subject (which Braid called hypnotism) have conducted interesting experiments for many years, under Professor Charcot, at the Salpêtrière, Paris, and Profesor Liébault at Nancy, the latter becoming known to fame as the originator of "hypnotic suggestion." Charcot is one of our foremost authorities on the management of hysteria, and has pursued the enquiry into hypnotism chiefly with reference to that abnormality of nerve function. We shall see, however, that the popular impression as to hysterical subjects being most predisposed to hypnotic influences is by no means proved.

At a general meeting of the British Medical Association held in August, 1889, a special section was devoted to hypnotism. It resulted in the expression of divergent opinions, in which, broadly speaking, French physicians maintained the affirmative and English physicians the negative view of the value of the study. Amongst the speakers was Dr. Voisin, of the Salpêtrière, who stated that he had by this means cured persons suffering from hallucinations and from sensory disturbances. Suicidal ideas and mania had disappeared under the use of the method. He had succeeded in curing dipsomania and morphinomania, as well as obstinate cases of juvenile depravity. Some of his patients had been put to sleep for from six to eight days. He had been able to transform his patients' habits of thought, and had brought them to love the good, whereas they before had only loved the evil. Dr. Yellowlees expressed amazement at these assertions, and remained incredulous, but Dr. Tuckey confirmed them from his experience of the practice of Dr. Liébault, who had successfully treated dipsomania and neuralgia. He cited the institution at Croydon, conducted by the Rev. Arthur Tooth, for the treatment of inebriates, where hypnotism was employed with much success, but he had been disappointed in the results of its application to the cure of melancholia, only 6 per cent. of the patients having proved susceptible. In the majority of cases it was not true that a patient after hynotism remained a mere tool in the hands of the operator. Dr. Ireland remarked that Braid had made claims as startling as those of Dr. Voisin. In one instance which he had published a flow of milk had been brought into one breast of a woman, while the other remained flaccid. Dr. Robertson said he had visited the Salpétrière Asylum, and could corroborate Dr. Voisin. Dr. Percy Smith, of Bethlem Hospital, concurred with Dr. Yellowlees. He had made trial of the method with the assistance of a professional hypnotiser, and the results had been almost entirely negative; in fact, he had not been able to get insane patients into the hypnotic state. It seemed impossible to secure the necessary attention. This view of the question was confirmed by Dr. Goodall and others. Dr. Turnbull Smith asserted that in his experience nineteen patients out of every twenty had proved to be susceptible, but in some cases only after repeated attempts. Exhaustion of the optic nerve by means of staring had been found most efficacious.

This divergence of opinion extends to the methods recommended. Dr. Forel, of Zurich, states that he had noticed very ill-effects from using what he terms "the old bad method of fixation of vision."

Last year the attention of the medical profession in England was aroused by the report of a meeting held at Leeds, on March 28, of some sixty medical men and dentists assembled, at the invitation of Messrs. Carter Brothers, to witness a series of operations under the hypnotic influence of Dr. Milne Bramwell.

The first case was hypnotised at a word, and three teeth extracted without the operation having been felt.

The next case was that of a servant girl, M. A. W., aged 19, on whom, under the hypnotic influence induced by Dr.

Bramwell, Mr. Hewetson had a fortnight previously opened and scraped freely, without knowledge or pain, a large lachrymal abscess, extending into the cheek. Furthermore, the dressing had been daily performed and the cavity freely syringed under hypnotic anæsthesia, the "healing suggestions" being daily given to the patient, to which Dr. Bramwell in a great measure attributes the very rapid healing. She was put to sleep by the following letter from Dr. Bramwell, addressed to Mr. Turner:—

"Burlington Crescent, Goole, Yorks. Dear Mr. Turner,—I send you a patient with enclosed order. When you give it to her she will fall asleep at once and obey your commands.—J. MILNE BRAMWELL.

"Order.—Go to sleep at once, by order of Dr. Bramwell, and obey Mr. Turner's commands.—J. MILNE BRAMWELL."

This experiment answered perfectly. Sleep was induced at once by reading the note, and was so profound that, at the end of a lengthy operation, in which sixteen stumps were removed, she awoke smiling, and insisted that she had felt no pain, and, what was remarkable, there was no pain in her mouth. She was found after some time, when unobserved, reading the *Graphic* in the waiting-room as if nothing had happened. During the whole time she did everything which Mr. Turner suggested, but it was observed that there was a diminished flow of saliva and that the corneal reflexes were absent, the breathing more noisy than ordinarily, and the pulse slower.

Dr. Bramwell took occasion to explain that the next case, a boy aged 8, was a severe test, and would probably not succeed, partly because the patient was so young, and chiefly because he had not attempted to produce hypnotic anæsthesia earlier than two days before. He also explained that patients require training in this form of anæsthesia, the time of training, or preparation, varying with each individual. However, he was so far hypnotised that he allowed Mr. Mayo Robson to operate on the great toe, removing a bony growth and part of the first phalanx, with the result that he appeared to know very little of what had been done.

It was necessary in this case for Dr. Bramwell to repeat the hypnotic suggestions. Dr. Bramwell remarked that he wished to show a case that was less likely to be perfectly successful than the others, so as to enable those present to see the difficult as well as the apparently easy straightforward cases; "in fact," as he said, "to show his work in the rough."

The next case was a girl of 15, highly sensitive, requiring the removal of enlarged tonsils. At the request of Dr. Bramwell Mr. Hewetson was enabled in the hypnotic state to extract each tonsil with ease, the girl, by suggestion of the hypnotiser, obeying every request of the operator, though in a state of perfect anæsthesia. In the same way Mr. Hewetson removed a cyst of the size of a horse bean from the side of the nose of a young woman who was perfectly anæsthetised and breathing deeply, and who, on coming round by order, protested "that the operation had not been commenced."

Mr. Turner then extracted two teeth from a man with equal success, after which Dr. Bramwell explained how his patients had been completely cured of drunkenness by hypnotic suggestion. To prove this to those present, and to show the interesting psychological results, the man was hypnotised, and in that state he was shown a glass of water; he was told by Dr. Bramwell that it was "bad beer." He was then told to awake, and the glass of water offered him by Dr. Bramwell. He put it to his lips, and at once spat out the "offensive liquid."

Mr. T. S. Carter next extracted a very difficult impacted stump from a railway navvy as successfully as the previous case. Dr. Bramwell described how this man had been completely cured of very obstinate facial neuralgia by hypnotism, which had been produced by working in a wet cutting. On the third day of hypnotism the neuralgia had entirely disappeared (now some weeks ago) and had not returned. The man had obtained refreshing hypnotic sleep at nights, being put to sleep by his daughter through a note from Dr. Bramwell or by a telegram, both methods succeeding perfectly.

The facts as recorded may be taken as establishing the existence of hypnotism and of hypnotic suggestion. The divergent opinions of practitioners are, however, very hard to reconcile.

Dr. Moll denies that any hysteria or weakness of any kind in the physique of a patient leads to his being more readily hypnotised. Professor Wetterstrand says it depends more on character than temperament, and that the most impressionable ages are from 3 to 15, fit subjects after the age of 30 being rare. Dr. Sherman Bigg maintains that no man of average capacity can be hypnotised against his will, and that even when hypnotised he can restrict the hypnotiser's influence. Professor Bernheim believes that the suggested effects exist only in the idea of the patient; that if it is suggested that he cannot see a certain object he continues to see it, but imagines he does not, and acts accordingly. He is of opinion that the number of persons who can be readily influenced is very limited, and yet at a demonstration given in Paris he elicited confessions of imaginary crimes, weeping, laughter, dumbness and powerlessness at will from persons who had not been previously hypnotised, and who, to all appearance, were in full possession of their senses, playing on their nervous system as upon an instrument.

At a meeting of the Medical Institute of Liverpool Dr. Grossmann reported he had seen Dr. Bernheim hypnotise one patient after another in his hospital wards until not one remained awake; also that a blister was produced by the application of a postage stamp, which, it was suggested, would act as a vesicant.

Dr. Liébault asserts that concentration of a patient's mind on the idea of sleep will induce sleep by leading to forgetfulness of the outer world and to a state in which suggestions are readily adopted and acted on, the hypnotic differing from the ordinary sleep in that there exists a relation between the sleeper and the operator. Dr. Forel considers that hypnotism is a state of sleep artificially induced, during which the course of the patient's dreams can be influenced. It depends, firstly, on the power of falling asleep easily; and, secondly, on willingness to submit to the operator's will, the disappearance of nervous symptoms being explained in the same way as the sudden cessation of toothache or sciatica after a shock. He could induce sleep readily in fifty patients out of seventy-two.

The school of Nancy teaches that the lethargic, cataleptic, and somnambulic stages of hypnotism can be produced at any time by the suggestion of the operator, suggestion being the key to all the phenomena. The psycological stages of hypnotism, although they may be divided into three—lethargy, catalepsy, and somnambulism—are variously classified by different observers.

According to Wetterstrand they reveal:—

1. Sleepiness and sense of weight.
2. Inability to move a muscle.
3. Unconscious automatic movements.
4. Consciousness only of the operator and obedience to his will.
5. Somnambulism and complete insensibility.

According to Haidenheim:—

1. Imitative movements.
2. Exaltation of special senses.
3. Illusions and hallucinations.
4. Loss of pain and of sensation.
5. Tonic spasms.
6. Spasms of the ocular muscles, dilatation of the pupils, accelerated pulse and respiration.

According to Liébault:—

1. Torpor of limbs and somnolence, the will power being still available if needed.
2. Retention by the limbs of any strained posture, the patient still remaining conscious.

3. Perception of the operator only.
4. Advanced automatism.
5. Oblivion.
6. Submission to the operator's suggestions.
7. Susceptibility to post-hypnotic influence.

The methods of operators vary. Some employ slow passes made at a short distance, some stroking, some ocular fixation, some orbital compression, some any weak, continuous, and prolonged stimulation of the nerves of sight, touch, or hearing, some verbal suggestion alone. Haidenheim invites the patient to sit down, tells him that sleep will cure him, urges him to concentrate his mind entirely on sleep, looking at him very keenly all the while; tells him he will feel weight in his eyeballs and limbs, and gradually be unable to move. And when sleep has been induced the desired instructions are suggested to him.

Liébault begins by reassuring the patient, telling him to banish all fear and extraneous thoughts, to concentrate his mind upon following the operator's words and suggestions. He then suggests the stages of sleep one by one as follow:—Your eyelids are becoming heavy; you can hardly keep them open. My voice sounds more and more distant. Your sight grows dim; objects appear indistinct. Numbness is creeping over your limbs. You cannot keep awake; your eyes are shut. (Here he closes the patient's eyes.) You are fast asleep. He then rubs any affected parts, suggesting that pain is to pass away; that disturbed functions are to be restored to normal action, and so on, concluding with the suggestion that no hypnotiser's influence except his own shall be obeyed. He arouses the patient by a word or a few passes across the face. The foregoing cannot fail to remind us of the reported procedure of American faith healers.

Charcot induces the stage of lethargy either by compressing the eyelids or by causing the patient to gaze fixedly at a bright point; that of catalepsy by lifting the eyelids during the preceding stage or by a sudden flash or shock, and that of somnambulism by gently rubbing the top of the patient's head.

Variety of opinion and of practice is accompanied by variety of theory. Among theorists Mr. Julian Hawthorne regards hypnotism as akin to the mental exaltation of the poet and the orator. Dr. Regnier finds in it nothing of this sort, not even the ecstasy of the martyr or religious devotee. The practice is not devoid of danger. Dr. Julius Lolow records how an amateur at a friend's house volunteered to hypnotise another visitor, and after two trials succeeded so well that the subject became extremely excited, lost the power of speech, and then passed into the condition of catalepsy. Subsequently he had severe convulsions. He had been hypnotised by being made to look at a diamond ring, and afterwards the sight of anything glittering threw him into a state of violent excitement. The floor of the room in which the physician found him was covered with cushions, as he frequently threw himself from the sofa on to the floor. He performed various odd automatic movements, slept only in snatches, awaking in nightmare, and, in fact, was in a condition to which the French physicians would probably apply the term grave hysteria with maniacal excitement. He was treated with full doses of sedative drugs, but did not at first show any signs of amendment. After ten days the convulsive attacks were replaced by periods during which he sang persistently. He would sing over song after song, apparently every song he knew, and as long as one song remained unsung nothing would stop him. After about a fortnight of this sort of thing he had an attack of fever, followed by copious perspiration and asthma. A few days later he had another feverish attack, again followed by perspiration, after which he declared himself quite well. From first to last he was seriously ill for three weeks. The cause of the fever is not very clear. His physician believed it was probably due to inflammation of the anterior part of the brain. Instances similar to this have not been infrequent. It has therefore been resolved by the committee of the British Medical Association that public exhibitions of hypnotism are dangerous, and should be prohibited, a prohibition which has already become law in Belgium, France, Russia, and Portugal, the only result to State medicine of the study of hypnotism thus far.

I have hitherto been dealing with facts which appear to obtain general acceptance. Allegations are made as to further phenomena which require a good deal more patience in investigation. The power of raising a blister by means of an inert postage stamp or of causing a patient to obey commands given by letter shortly after leaving the hypnotiser is transcended by the alleged power to compel obedience after a considerable lapse of time. Induction of a condition of double consciousness, alternation of two separate mental states, lasting each for considerable periods, in which two different personalities, unconscious of each other, are revealed, is more extraordinary still, while the marvels of somnambulism, the display of faculties independent of the senses, reading with bandaged eyes, and description of simultaneous remote occurrences rival old legends of possession.

It will be useful to give you a brief sketch of the observations which preceded hypnotism. When we remember that this is not a new science, but only a new name, and that it is the habit of mankind to re-christen and adopt to-day many things which it rejected and reprobated yesterday, it should make us tolerant of other allegations the truth of which is not yet established.

About 1670 a gentleman named Valentine Greatrex, the "stroker" who had acquired repute as a healer of disease by what was probably a combination of hypnotism and massage, was actually commissioned by King Charles II. to exercise his skill during the prevalence of certain epidemic diseases. In 1772 Anthony Mesmer, M.D., of Berlin, began to investigate the influence of magnetism, and is said to have effected many cures. On propounding his theory of animal magnetism he provoked a storm of envy and malice which overwhelmed him, many of his patients, even after their transports of gratitude had cooled, being so swayed by popular prejudice as to aver that their cures must have been effected by chance. He was ejected from Germany, and no University deigned to give his claims fair trial, though they have come down to us under his name as "Mesmerism."

Surgeons of reputation, Recamier in 1829, Cloquet, and others, made occasional use of the method. In 1837 Dr. Elliotson established in London a Mesmeric Hospital, where he performed serious operations painlessly, but as he persisted in proclaiming the superinduced phenomena of "clairvoyance," transposition of the senses, etc., etc., he evoked a storm of contumely which upset the balance of his mind, and led to the termination of his existence by his own hand.

At about the same time that Braid began his experiments Dr. Esdaile, in India, in ignorance of those experiments, and under very different conditions, arrived at similar results. After five years' practice he left a record in Calcutta of 261 painless operations of severe character. This direct continuation of the practice, from Mesmer down to Charcot and Liébault, ought to influence our tardy recognition of the source to which honour is due.

A view prevails among the modern differing from that of the ancient professors of hypnotism. The former generally consider the phenomena to be wholly subjective, whereas the latter tended to the belief that they were objective. It is noticeable, however, that the former are not ignorant of the passage of some influence from the operator to the subject, Liébault admitting that "there exists a relation" between them, and Haidenheim when hypnotising looking at the patient "very keenly."

The belief that there is some emanation from the operator resolves itself, in my mind, into a recognition of the telepathic force of will power; that there is a transference of ideas from brain to brain. This transfer of force seems, like the zymotic diseases, to require an incubation period, which incubation period in this instance is characterised by somnolence or lethargy.

The British Medical Association recognises that hypnotism cannot be considered a general remedy of reliable action, and lays down the rule that a stranger should never be hypnotised without a suitable witness. No satisfactory explanation having yet been given, I am justified in assuming that the medical profession has now got hold of something which we do not understand. My mind was a *tabula rasa* as regards this subject, when, fifteen years ago, finding myself possessed of means and leisure, I undertook to study hypnotism and allied phenomena. Attracted by an advertisement, I made acquaintance with an illiterate man named Ashton, proprietor of a sort of hospital for magnetic healing, and took from him a series of lessons in his art. He was able to alleviate pain and disease chiefly of joints, displaying diligent patience and manipulative skill. I was impressed that a force emanated from him. On one occasion when he was declaiming in front of me at some 6 feet distance the rise and fall of his arms (he was a vehement gesticulator) when directed towards me so affected my nerves that I had to ask him to desist. After twelve lessons I found that I could generally relieve slight neuralgias of my friends and family. My opportunities were few. I could not go about gathering patients. The faculty I had acquired became enfeebled and left me through want of use, in accordance with Ashton's doctrine that it could be acquired and cultivated only by constant practice in most instances. After this I went through the whole round of spiritualism that was accessible to me, finding it wholly unprofitable to the mind, until I obtained an introduction to a well-known old gentleman, a Mr. Frederick Hockley, a man of erudition, but apparently of great credulity. His claims to a knowledge and practice of the occult sciences, made to me in confidence, simply, modestly, and as a matter of course, were little less than those of the mediæval magicians. Thirst for knowledge led to my becoming his most intimate friend, to whom he bared his heart, his history, and his lore. I cannot too highly estimate his goodness and nobility of mind. A bibliophite and bookhunter, he possessed an extensive and very valuable library of books and MSS. (now in the British Museum by his bequest), but the series of his own minutely-kept diaries, ranged in handsome bindings on his shelves, inspired me with more interest than all. He had long abandoned all other occult practice to devote himself to what we call "divination" by mirrors and crystals, consideration of which, I believe, will be found to throw a side light upon hypnotism. The notes of his numerous experiences, or, as he called them, "actions," bore by turns upon the most interesting metaphysical discussions, revelations on past, current, and in some instances future events, and scenes and anecdotes like those of an enthralling novel. The key to all the unexplained phenomena revealed by hypnotism and by all his studies is, he taught, to be found in concentration of will power by the operator.

Society has of late years been exercised in mind about thought transference and telepathy. We are familiar with drawing-room experiences of collective will power over one of a company who may thus be impelled to perform almost any incongruous act. I feel convinced that individual will power concentrated upon another by one who is able to use it, and under favourable conditions, must be reckoned remarkable, and in some cases irresistible. A sad case of the unintentional misuse of the influence is within my knowledge. About twenty years ago an officer in garrison at Malta found he thus was able to control the actions of a young member of the ancient nobility of that island, and was accustomed to amuse his brother officers at the expense of that gentleman. He carried it so far as to cause the victim to pick pockets. The officer returned to England, and some time afterward many small articles having been missed from the Club a detective was employed, who traced the thefts to the nobleman in question. The culprit was tried, found guilty, and sentenced, to the disgrace of his family and the ruin of his career.

Obedience by the subject in after days to suggestions given in the hypnotic state appears to be an extension of the influence which we are not able to explain. The supersensuous perceptions alleged to become manifest during the stage of somnambulism appear to be related to those recorded by Frederick Hockley from hypnotism by mirrors and crystals, and are equally unexplained. The evidence for this class of unexplained phenomena is becoming very strong, and rebuts dogmatism on the subject. Bearing in mind the slow stages of official recognition accorded to the simpler facts of hypnotism, we cannot be surprised at delay in the acceptance of its more advanced phenomena. These in former days always ruined the reputation of those who attested them.

A writer in the April number of the *Nineteenth Century* magazine, reviewing the claims of the advanced phenomena and urging them on the consideration of men of science, asserts "That it is possible for an experimenter to produce a hallucinatory image of himself in the perception of a friend at a distance without the friends having received any previous suggestion or anticipation that such an image would appear," and claims it as a fact "attested in several instances by trustworthy persons at each end of the chain." This claim, if it can be substantiated, may be found to correlate the admitted phenomena of hypnotism and telepathy with the astounding claims of the late Frederick Hockley.

Amongst instances where revelations received through his mirrors were confirmed by subsequent independent evidence is that which has been frequently quoted in spiritualistic literature of the minute description of a startling incident which occurred to the late Sir Richard Burton during his journey, in disguise, to Mecca, at a time when the world had given him up for lost. This vision, recorded in Hockley's diary simultaneously with the event, was verified and attested by Burton on his return. In the same diary stand recorded the ruin of the Tuileries and the attendant conflagrations in Paris years before the events of the Commune.

Amongst the array of extraordinary pretensions which the close of this century is reviewing we may detect much fraud, much collusion, imagination, and credulity, yet if anyone will devote three years, as I did, to their patient investigation, I say that he will be unable to deny the presence of some facts whose nature and relations to explained facts he will be unable to explain. And this is the attitude of the scientific world towards hypnotism.

ELECTRIC TRACTION.

By Montague Rhys Jones, C.E.

Whether the present generation has discovered the ultimate force in nature most applicable to the service of man is a question for the scientist of the future to answer. We can, however, claim this to be the electrical age, as in prehistoric times there were ages of stone and bronze, and in introducing the phenomenon of electricity, as applied to traction, we cannot help being forcibly reminded of the unity and continuity of nature, when we consider how the method of applying this unknown force has, like all other physical and social phenomena, "ever from simpler to more complex grown;" it now remains an important part of our environment and if we failed to correspond the result would be a retrograde movement of the human species.

Passing over its agency as a transmitter and reproducer of thought and sound, and other commercial and industrial functions, we come to its latest evolution in its application to the propulsion of railway and tramway cars. Its practical utility was first demonstrated at Berlin, in 1879, by Siemens and Halske, on an experimental line of 500 metres. The train consisted of a small electric locomotive and carriages, which had very small wheels, with two rows of seats running parallel with the rails. The locomotive was fitted up with one of Siemens' dynamo-electric machines, laid horizontally on a frame-work with wheels, the bobbin being parallel to the rails, and the field electric magnets perpendicular thereto. The rotary movement of the bobbin was transformed and transmitted to the driving wheels of the small locomotive by cog wheels, and a bevelled wheel completed the communication of the movement. A bar of iron, to introduce the current, was laid between the two rails, and encased in wood, to insulate it electrically from the soil; "two spring rubbers attached to the locomotive rested on the bar. The current was transmitted by these rubbers into the machine; after having done its work it passed through the wheels of the locomotive, and back to the generator by the iron rails. It was not necessary for the rails to be completely insulated, for if some of the current escaped into the earth, it still returned to the generator, that being equally connected with the ground."

The success of this experiment led to other attempts of an exhibitional nature, at Brussels, Durseldorf, Frankfort, and other places with the same result, and then electrical traction passed from the experimental to the commercial process of development, and the Lichterfelde Electric Tram near Berlin was the first of this kind. The length is one and a half miles, and the equipment in 1881 consisted of two motor cars, the motion being transmitted to the wheels by belts working on grooved pulleys outside the wheels. The prime source of power was a steam engine, with a Siemens' motor and generator; but the installation differed in some respects to the Berlin line, the central rail not being used, but the one rail acting as a lead, and the other as a return for the current. Up to 1887 this line carried a hundred thousand passengers yearly. These instances are merely recorded to show that the inception of Electrical Tramways took place in Europe, the principle being the generation of electricity by dynamo, and conveying the current through conductors connected by sliding contact with the cars while in motion. Modern electrical railways are now built chiefly on this principle, although America has far superseded Europe in the improvement and perfecting of the system.

After the year 1881 the commercial aspect of electric traction was carefully considered, and numerous lines were constructed both in Europe and America. In the former the mines of Zankeroid and Hohenzollern constructed short tramways the system of conductors, being overhead inverted T rails. They each carried 300 tons daily, at a cost of a halfpenny and three farthings respectively. The first electrical tramway in England was projected and constructed by Mr. Mangus Volk, at Brighton, in 1883. It runs along the sea beach for about one mile, and includes some heavy grades and sharp curves. The speed was limited to eight miles per hour, but twenty-five miles has been done. The current is transmitted along the rails, with a gas engine as prime power. One million passengers are carried yearly, at a cost of 1·92 pence per car mile, and nearly 50,000 miles are run during the year. In 1883 followed Port Rush, in Ireland, with a six mile length of single track, the current being sent along a third rail by water power. And here let me state that, in my opinion, both Hobart and Launceston are eminently suitable for electrical enterprise, and that a well digested scheme of electrical tramways could be devised for both places, as would compare favourably in point of economical working with any system in the world, owing to the existence of an abundant and permanent head of water, which could be utilised for the generation of electrical power, but a radical alteration would be necessary in respect to the permanent way which is now being laid down in Hobart. The rolling surface is of such a crude character as will not only seriously affect vehicular traffic, but the successful operation of electrical trams.

In rapid succession followed Blackpool with an underground system, technically known as the conduit system. Mordling, Frankfort-Offenbach, with overhead slotted tubes as conductors. Brussels and Hamburgh followed in 1886 and 1887 with the Juien system of storage batteries, which, as will be subsequently explained, proved a failure. So far as America is concerned she has left us far behind in the race for cheap transit.

The first electric railway in America was exhibted at the Chicago Exhibition, in 1883, by Messrs. Field and Edison, the track running round the gallery of the main building, curving sharp at both ends, with a radius of 566 feet. The total length was 1,500 feet. The gauge was three feet, with a central rail for the current, and the two outer rails for returns. On June 5th, the "Judge" and its car, loaded with sixteen passengers, was started. The railway ran for a fortnight, completing a mileage of 446, and carried 27,000 passengers. The trial was considered a success. Mr. Leo Daft then began experimenting with his electric locomotive, the "Ampere." The actual performance was the hauling of a railway car weighing ten tons with sixty-eight persons in addition to the motor, which weighed two tons and carried five persons. The speed was eight miles per hour, upon a track having a gradient of 93 feet to the mile, and included a 20 degree curve. A maximum duty of about 12 h.p. was registered; and, although the actual efficiency was not determined, the 25 h.p. engine which actuated the primary machine was also doing other work at the factory.

The first electric tram open for traffic in America was the Baltimore Union Passenger Railway, in 1885; it had two miles of single track, six cars, and 260,000 passengers were carried yearly up to 1887, at a cost of 16s. per car per day, each running 73 miles daily; a third rail was introduced as a conductor, also an overhead wire. Electrical progress in America since that date has been simply astounding. In the beginning of 1890, one hundred and fifty towns had electric trams, aggregating 1,670 miles of track, with 2,650 motor cars, equivalent to 70,000 h.p., running 150,000 miles per day, and carrying 200 millions of passengers yearly. The prime source of power required to meet this gigantic traffic is estimated at 40,000 h.p., and it is stated, on the authority of those competent to form an opinion, that 3,000 motors will be at work this year, carrying 3 millions of people, and calculated to return in fares about 3 millions sterling.

It is always a profoundly interesting thing to know something of the historical development of a force which is destined to greatly modify the physical and mental attributes of man, and if an apology be needed for entering so fully into the historical detail connected with the subject, that is my sole excuse.

Before proceeding to describe the methods of application, and so as to afford those who have not had an opportunity of studying the subject, it is proposed to briefly enter into an historical and physical description of the dynamo and motor, two of the most important agents in the application of electricity as a motive power, which will, it is hoped, enable them to have a thorough grasp of the principle.

Before explaining the physical theory of the dynamo, it may not be outside the scope of this paper to briefly refer to Faraday's discovery in 1831 of the laws of magnetic-electric induction. He found that induced currents could be started or stopped in an adjacent coil, which led to the further discovery that currents could be generated in a coil moved in the poles of a powerful steel magnet. He then made what he termed a "new electrical machine," whose parts consisted of a copper disc 12 diameter, and one-fifth of an inch in thickness, fixed on a brass axle, and mounted in frames so as to revolve, its edge being placed between the poles of a large compound permanent magnet. Copper and lead conducting strips were placed in contact with the edge of the disc, a wire from the galvanometer was connected to the collecting strip and the other to the brass axle. On revolving the disc a deflection of the galvanometer was obtained, which was reversed in direction when the direction of the rotation was reversed. Here, therefôre, was demonstrated the production of a permanent current of electricity by ordinary magnets. From 1832 many inventions and improvements followed, until 1848, when Brett made the important suggestion of causing the current developed in the armature by the permanent magnetism of the field magnets to be transmitted through a coil of wire surrounding the magnet, so as to increase its action. This improvement marked an era in the evolution of the dynamo, being the first suggestion of the self-exciting dynamo. Then followed a period of great activity, when further improvements were effected, and in 1867 Dr. Werner Siemens described in the Berlin Academy a machine for generating electric currents by the application of mechanical power, the currents being induced in the coils of a rotating armature, by the action of electro-magnets, which were themselves excited by the currents so generated. To mark the importance of this departure, Siemens coined the word "dynamo-electric machine," which now is shortened into "dynamo," and which has now become the name for all these electric machines driven by mechanical power, whether self-excited or not. Brush introduced his famous dynamo of a shunt and series winding for the purpose of enabling the machine to do either a large or small amount of work. Many other Americans produced dynamos, amongst them being Edison. The dynamo was now brought up to a great state of perfection, and since the year 1883 the chief progress made has been in details of design and mechanical construction.

I will now proceed, as briefly as possible, to illustrate the physical theory of dynamo-electric machines, which I hope will enable us to understand more clearly the part they play in the propulsion of tramway cars. Professor Sylvanus Thompson defines a dynamo-electric machine as " a machine for converting energy in the form of mechanical power into energy in the form of electric currents, or *vice versa*, by the operation of setting conductors to rotate in a magnetic field, or by varying a magnetic field in the presence of conductors." Projected on the screen is a magnet with electric tufts from the North to South poles. (Plate I.) If iron filings were placed in these magnetic fields, they would arrange themselves thus:—(Plate II.) Now, if we place a conductor, such as a piece of copper wire, in this magnetic field, as it is technically called, and moved it about intercepting these lines, an amount of electricity would be generated in the conductor at right angles to the course of the movement of the conductor, and also at right angles to the direction of the lines of force. "This induced current is purely conditional on the intensity of the magnetic field, and the length and velocity of the moving conductors, as well as the resistance of the wire to the current." Now, as to what this current is, no one knows. It is one of those ultimate scientific facts at present behind the veil. Here is another diagram showing the magnetic field surrounding the conducting wire, end on. (Plate III.) Every wire, as Professor Thompson puts it, "is surrounded by a sort of magnetic whirl," thus:—(Plate IV.) To do this wants energy, and that constant, if to be maintained. It is these whirls which act on magnets, and cause them to set, as galvanometer needles do, at right angles to the conducting wire. It must, however, be remembered that a moving conductor in its motion must cut the lines of force that pass through the circuit of which the moving conductor forms part. I cannot illustrate this fundamental truth better than by throwing upon the screen a few diagrams of Professor Thompson's, and by quoting him on the subject:—"If a coil or wire circuit be moved along in a uniform magnetic field, as indicated in this diagram (Plate V.), so that only the same lines of force pass through it, no electric current will be generated; or if, again, as in this diagram (Plate VI.), the coil be moved by a motion of translation to another part of the uniform field, as many lines of force will be left behind as are gained in advancing from its first to its second position, and there will be no current generated in the coil; but if, as in this figure (Plate VII.), the coil be tilted in its motion across the uniform field, or rotated round any axis in its own plane, then the number of lines of force that traverse it will be altered and currents will be generated. These currents will flow round the ring coil in the positive sense. 'The positive sense of motion round a circle,' I may here add, 'is here taken as opposite to the sense in which the hands of a clock go round.' If the effect of the movement is to diminish the number of lines of force that cross the coil they will flow round in the opposite sense. If the effect is to increase the number of intercepted lines of force, if the field force be not a uniform one, then the effect of taking the coil by a simple motion of translation from the place where the lines are more dense to a place where they are less dense, as from position 1 to 2 on this diagram (Plate VIII.), will be to generate currents, or if the motion be to a place where the lines of force run in the reverse direction the effect will be the same, but even more powerful."

From the foregoing simple facts some very important consequences are apparent, the principal of which are these:—"Currents can be generated in conductors by setting up magnetic whirls round them. We can set up magnetic whirls in conductors by moving magnets near them or moving them near magnets. This means energy and an expenditure of power. The more rapid the motion the stronger the current, and by using a suitable commutator or guide all the currents, direct or inverse, produced during recession or approach can be turned into the same direction in the wire that goes to supply currents to the external circuit, thereby yielding an almost uniform current."

A very large number of dynamo-electric machines have been constructed on the foregoing principles, and the variety is legion, but the ones most used for the purpose of electric traction are those in which there is a rotation of a coil or coils in a uniform field of force, such rotation being effected (as in this diagram—repeat Diagram VII.) round an axis in the plane of the coil or one parallel to such an axis.

An electric motor is the reverse in its action to the dynamo, the latter converting mechanical energy into electrical force, and the former conversely transforms the current of electricity supplied by the dynamo from electrical force again into mechanical energy, thereby propelling the cars. The electric motor "includes all apparatus through whose employment work is performed." Everyone, no doubt, has heard of "Barlow's wheel." This was the first elementary electric motor. He found that by passing a current from the centre to the circumference of a copper disc between the poles of a magnet the disc would revolve. Faraday, you will have observed, in his researches in induction, reversed Barlow's experiment, but those discoveries resulted in the dynamo. It was not until 1873 that the reversibility of the dynamo was discovered, although for many years previous to this motors for driving machinery were operated, but depended on the galvanic battery for a supply of current. This process, being a very limited one, went to the wall when a cheaper current was effected by the discovery of the dynamo. The action of the practical and commercial motor now used is that of a magnet and a wire conveying a current, and is the reverse action of the dynamo, in which the motion of the conductor generates the current. On the other hand, a current in the conductor creates motion.

The law of the survival of the fittest has been an important factor in reference to types and varieties of the motor, not only in many mechanical appliances, but other resources resorted to to intensify the currents.

Having, it is hoped, given a clear insight into the theory of these electrical machines it is to be regretted that the limits of this paper will not permit a detailed description of the mechanical parts (Diagram of Sprague's Motor—A); but so long as the elementary truths have been retained, and that they will be brought to bear on the more descriptive portions of this paper, the object of the same will have been attained.

There are two methods of applying electricity for traction purposes—(1) by storage batteries; and (2) by metallic conductors over and under the track, known as the "overhead system" and the "underground" system respectively. These methods, however, are both of a direct nature, the motors being supplied with current from the conductors as wanted. As an ideal method of propulsion the storage or accumulator system stands pre-eminently foremost, and the best electrical intellects of the day are devising and improving with a view to eliminate the many defects which prevent it from being introduced commercially. The batteries occupy but little room, and are placed under the seats, and the motor is placed under the body of the car. There is no smoke or dust or accompanying noise and no street gearing, and the æsthetic sense is greatly conciliated by its attractive and graceful movement without contact. This is all very well on paper, but when brought into actual experience, like all ideals, it falls short of expectation. The serious objections to its commercial employment are that the accumulators are composed of lead, weighing altogether about 3,500 lbs. in an ordinary street car, thereby reducing the electrical efficiency by nearly 60 per cent. These cells, stored with power, have to be always carried about, whether over heavy or light grades, and if the car has to surmount any grade over 5 per cent., which is common in streets, the capacity and discharge rate is so limited that it is with only great difficulty and serious injury to the mechanical parts that they can be negotiated, and the chemical energy of the cells instead of supplying current developes heat and buckles the cell plates. Platinum or gold might withstand this constant molecular activity; but then, again, it does not do away with the dead weight, to say nothing of expense; but I believe gelatinous cells are spoken of as being highly probable in place of the lead cells. Last January I was asked to value the assets of the Eaglehawk Electrical Tramway Company, which was operated on the storage system for about three months or more, and which proved an entire failure. Its cost amounted to £40,000, and the debris was worth about £5,000. It could have been nothing but ignorance that suggested the storage system for Sandhurst, as the street conditions were entirely unfavourable for such. It is indeed difficult to speculate what the ultimate destiny of the storage car will be, but if improved up to present commercial requirements the most perfect ideal of street transit will have been accomplished.

The underground system, in point of construction, is very much like the cable system, so far as relates to the conduit for carrying the conductor, and the chief objections to it are cost of construction. The conduit in a busy thoroughfare would probably have to be excavated without the use of explosives, at a great cost; and without a large wetted perimeter is allowed for during heavy rains the channel would be flooded, and the water and street debris would come in contact with the conductor, which cannot be fully insulated owing to contact with the trailer, which is suspended from the car, and from which the motor takes its supply of current. The efficiency is entirely destroyed by short circuits and leakage. There are many other mechanical difficulties to be overcome, and one of the great drawbacks which militate against its success is the large amount of ironwork on the surface of the street, together with difficulties of switching and cost of maintenance.

We now come to that system which has been most successfully operated, commercially and practically, throughout the world, and whose adherents and supporters are growing yearly, namely, the "overhead system." Overhead conductors consist of two elements, one having a metallic circuit of two parallel wires, and the other only one overhead wire, the rails and earth forming the return current. There are various methods of contact between the car and the overhead wire, but the one universally used is the single wire under contact system, with bearing wires suspended crossways in narrow streets and centre pole suspension in wide streets, the chief points in favour of these arrangements being the neatness and simplicity of construction, the ease and perfection of all switching, and the well designed and permanent attachment of the trolly arm, a balanced and pivoted pole attached to the car rendering the danger of a falling trolly a very remote contingency. (Plate VIII.)

There are two prominent firms in America who by their great ability and energy have been instrumental in carrying out most of the electric roads in America. I refer to Sprague and Thomson-Houston. There is little in point of difference between the systems of either firm, but I shall describe Sprague's system as a type of this modern electrical railway, having been in communication with that firm in reference to the design of a plant for an electrical tramway, whose conditions were of an exceptionally difficult character, there being a grade of 1 in 8½ for a distance of eight chains.

We have to consider five points in connection with the overhead system:—1. The power-house or generating station. 2. The conductor from the power-house to the car. 3. The motor attached to the car. 4. The connection between the motor and the axle of the car. 5. The return of the current to the power-house.

Thrown on the screen is one of Sprague's power-houses (Plate IX.), supplied with Armington and Sims' engines connected up to the dynamos, and thereby supplying the necessary mechanical power for the production of the current, and in designing these engines it is desirable that they should be so constructed that no variation of more than 2 per cent. in the speed should take place, whether there is a small amount of work to do or whether they are called upon to develop their highest capacity at any given moment, and it is always necessary to have the chief parts in duplicate in case of accident.

The conductor from the power-house to the car has undergone many modifications, but the plan which is now generally adopted is a trolly wheel, firmly fixed to a balanced and pivoted pole having a universal movement. This projects from the roof of the car, and is kept in contact with the conductor or overhead wire by aid of springs from below pressing it underneath and against the overhead wire.

With regard to the overhead work a three-tenths of an inch copper wire is stretched over the centre of the track. At every 120 feet it is suspended about 20 feet above the level of the street. This is done either by means of a bracket, as shown on the diagram (Plate X.), or from a thin cable stretched across the street from kerb to kerb, attached to poles either of wood or iron. This, of course, necessitates the insulation of the main wire by means of a small insulator made of mica and indiarubber.

The poles are planted in concrete to a depth of 6 or 8 feet and a good earth connection made, so that leakage of current can be grounded. The poles are very ornamental in design, and are capable not only of any amount of artistic embellishment, but can be practically used for electric lighting. On short roads the overhead wire provides current for the whole of the motors on the track, but on long lines, where traffic is heavy, feeders are resorted to, carried overhead or underground, and connected with the main overhead wire at intervals of 400 to 500 feet by small lateral or sub-feeders. The important features of this excellent system are the maintenance of a constant potential along the entire length of the road, avoiding a breakdown of the system in case of fires, congested street traffic, or the rupture of the overhead lines. Traffic would still be carried on at either side to the breach, or if by placing cross-over roads in the track at the ends of these sections the inconvenienee would be slight.

The next point to be explained is the motor and the connection between the motor and the axle of the car. (Plate XI.) You already know the main functions of the motor. The current is conducted to the motor under the floor of the car. The mechanism consists of a motor fixed under frame of car. On the end of the motor shaft a pinion gears into a spur wheel on an intermediate shaft. On the other end of the latter another pinion gears into a spur wheel on the driving axle of the car, and motion thereby being communicated. The Sprague motors are perfectly automatic, running at nearly the same speed for all roads up to the maximum, and adjusts itself to normal speed under sudden changes in load. A diagram showing a street railway current curve gives an idea of the erratic power-calls on the motor. (Plate XII.) As regards the system of braking, when a motor is in operation it is generating an electro-motive force. In other words, it is acting like a dynamo, and since this depends upon the strength of the field magnet and the intensity of motion, and since the field magnet strength is under positive control, it follows that the electro-motive force can be made to equal the initial motive force, and even to exceed it when this electro-motive force of the motor thus predominates. The machine will then become a generator and give current to the rails, and its mechanical effects are reversed, so that it brakes the train instead of propelling it.

For controlling the cars a series of levers are worked on the platforms, and a "rheostat" is used for throwing machines into circuit. The last item to be determined is the return of the current to the power-house. There are many methods, as have already been pointed out, namely, by earth plates being buried in damp soil and by rail; but in recent practice the complete metallic return, the same as the overhead wire laid on the top of the sleepers and between the rails, and connected with the latter close to the joints, is pronounced to be satisfactory.

Of course many objections of an æsthetical nature have been urged against the overhead gearing, but they are more apparent than real, and those who take their stand on such paltry objections I would recommend to look at the telegraph and telephone cables so obtrusively conspicuous in big towns. The telephone people have also complained that the ground return interferes with the successful operation of the telephone. The same argument could be brought against electric lighting and telegraphs. The telephone people could meet this chief objection by having a metallic return constructed, the cost of which would be a mere bagatelle. As regards the risk to human life by shock, the working potentiality of 500 volts is so low that it is hardly worth considering. Having touched the fringe of the principal objections a brief comparison, *pro* and *con*, with other systems of traction will be considered. Traction expenses on horse tramways amount to two-thirds of entire working expenses, to say nothing of its inhumanity; and as to steam, it is a clumsy but effective method of applying force, and the citizens of Hobart would be wanting in public spirit if they ever permitted steam engines to run along their streets. If a draughtsman sat down and deliberately attempted to design an affront to a decent community he could not have succeeded better than at Sydney. The working expenses of the steam trams there amount to 3s. per train mile. It is now generally admitted that the struggle for existence lies between the cable system and the electric. The cost of the construction of the former in Melbourne amounted to £34,000 per mile, and 75 per cent. of the available energy is lost by dragging the cable itself, while the whole of the energy can be utilised by the overhead system, excepting a few points per cent. due to resistance of the current by the overhead wires, to say nothing of numerous mechanical defects. At Minneapolis £80,000 was spent in the purchase of cable plant, but was cast on one side as scrap iron to make way for an electrical system. The cable system can certainly surmount phenomenal grades, but on the other hand the electrical tramway can negotiate 1 in 8 grades, or even less; it is only a question of power; and Mr. Reis, an electrical engineer, has made some very valuable discoveries as to electrical braking and adhesion, which I hope to see practically demonstrated at an early date.

As much as one would like to submit these different tramway systems to a searching analysis of cost, not only as regards construction, but working and maintenance; but having already overstepped the limits of a paper, I can simply record the fact that the Frankfort-Offenbach line in Germany is the most expensively worked tramway in Europe or America, the cost amounting to 4½d. per car mile. Mr. Crosby summarises the cost of working, etc., three of the principal lines in America:—"Interest on investment, one-quarter to one-fifth of the whole, *i.e.*, 1 cent per car mile, or, say, 20 per cent. of the total. Coal is about 12 per cent., attendance 40 per cent., machinery and line (without interest) about 20 per cent."

Here is a view of the Telpherage system. (Plate XIII.) It requires no earthworks, bridges, culverts, etc., as railways do. There are three lines worked on this system in England—Alexandra Park, half a mile; Glynde, a mile and a half; and Eastpool a mile and a half; the latter two for mineral purposes. I throw the suggestion out that they are admirably adapted for the developments that are taking place at the present time on the West Coast. It is difficult indeed to surmise what shape electrical developments will take in the future, its potentiality being apparently infinite. It is, however, no stretch of the imagination to say that it is the locomotive power of the future. In preparing this paper I have consulted Professor S. P. Thompson's works, Professor Ayrton, Du Moncel, Martin and Wetzler, and other scientific papers. (Plate XIV.)

DISCUSSION.

Mr. **Macfarlane** said:—Your Excellency and Gentlemen,—Having been asked to take part in the discussion following Mr. Montague Jones' excellent paper, I have pleasure in doing so, as I have had opportunity of gathering some information on this interesting subject, being in correspondence with a manufacturing company, makers of electric railway plant, the Thomson-Houston Company. There are only two or three points which I would desire to emphasise as of special general interest to the public, and the first point is that electric traction is not now confined to the region of scientific experiment, but is an established commercial success. In the United States there are 310 tramways or railroads worked by electricity, with 4,000 cars and 7,000 motors. In the city of Minneapolis a new and expensive cable has been abandoned and electricity adopted, and it is estimated that one-third of the street railway mileage in the States is worked by electric traction; and further, the following tramways, amongst others, pay a dividend of 8 per cent.:—The West End Road, Boston (probably the largest tramway company in the world), the Springfield, Troy and Lansenbury, and Utica and Mohawk tramways. These facts are sufficient to show that electric traction for tramways and railroads is a commercial success. I am speaking now of the overhead system, and on the general principle, for, of course, there are electric railroad companies which do not pay dividends, as in all commercial ventures. With regard to steep grades I may add 1 in 7 is not too steep for working. I believe the steepest grade in the proposed Hobart line is 1 in 16.

It is interesting to note further that electric traction has also been successfully applied to tramways for mills and manufactories, as well as to street railways, and is found a convenient method of transporting raw materials, manufactured products, coal, and other commodities from one part of the works to another. Electricity fully meets the requirements of such a case. The special advantages claimed for electricity over steam motors or locomotives are three in number, viz., safety, the removal of obstacles presented by grades, and economy. Its safety is seen from the fact that the road may be run through the mills and store-houses without increasing the insurance rates. Steam is unsuited to indoor work, and even when used entirely out of doors there is always some danger of fire, and there is the smoke and the noise and dirt arising from the locomotive. In the matter of grades, whilst 4 per cent. (1 in 25) is about the maximum which steam can overcome, grades of 12 per cent. (1 in $8\frac{1}{2}$), or more, are easily surmounted by electricity. The expense for horse-power of running a steam locomotive in comparison with a large stationary engine, where all the advantages of concentration are available, shows decided economy in favour of the large plant. Electricity furnishes a means for transmission of power with minimum loss and cost, permitting the concentration of the generating plant, whether steam or water power, and thus appeals strongly to the business man on the ground of economy. One advantage possessed by electricity alone is that the overhead wire may be tapped anywhere, and a stationary motor, an electric hoist, a pump, or any form of electric-power machine operated from it. Electric traction is in use at the works of the Baltimore

Sugar Refinery, Pittsburgh Plate Glass Company's, Trenton Iron Works, and many other mills and factories.

As to the safety of the overhead wire system in regard to freedom from accident or danger to human life, it is very satisfactory to have reliable and independent testimony apart from experts or officials connected with manufacturing companies. The *Boston Daily Advertiser*, the well-known Conservative journal of a Conservative city, addressed letters to the Mayors of the various cities in which the overhead system of electric tramways was in use. The questions submitted were:—1st. What system of electric cars is in use in your city? 2nd. Whether any persons have been seriously injured or killed? 3rd. Whether any apprehension is felt among your people as to safety on account of this electric system? 4th. Whether, as a result of its introduction, the street car service is improved? 5th. Whether popular feeling is in favour of the overhead wires, or hostile to it? In reply 69 answers were received from as many cities, which were published in the *Advertiser*, appearing on the 26th August, 1890. In regard to the third, fourth, and fifth questions the consensus of public opinion is exceedingly favourable; and on the point of danger raised by the second question the *Advertiser*, in summing up, says:—" We find that of the 69 cities reports of accidents are confined to 15. Of these only 8 resulted in serious or fatal injuries to human beings, the others being the killing of horses by falling wires. Of the human beings killed, in all but two cases the accident was due to other causes than the electric wires, and in both cases where the wires apparently brought death they were by electric light wires. We have not heard of a single death from the trolly wire." It must be admitted this independent testimony is very satisfactory.

Nashville, Tennessee, claims to have the largest electric railway system in the States, excepting the city of Boston. And I will conclude this short sketch with an extract from the Mayor of Nashville's letter in reply to the questions submitted by the *Boston Daily Advertiser*:—" No person has been injured by the system. Three horses have, however, been killed, caused by rusted telephone wires falling across the trolly wire and conveying the current from the trolly wire to the ground. In one instance when one of these accidents occurred a Negro woman, in attempting to pass, grabbed"—[Excuse the expression; it is not mine, but the worthy Mayor's.]—" the telephone wire, and was thrown to the ground. She naturally did right smart 'high kicking,' but she immediately arose, much frightened, but in nowise injured. From this it seems that while the trolly wire conveys sufficient electricity to kill a horse, yet there is not sufficient current to kill a human being."

Mr. C. W. S. James, C.E., said he had been deeply interested in the paper read, and had tried to think how far the electric traction system could be applied to Hobart. A few months ago he had estimated what could be done in Launceston by utilising the South Esk River, and he thought that there from 1,000 to 1,300 horse-power could be available. In regard to Hobart, however, there was not the same power available, and he believed they would require to look to generated power in any electrical system introduced. He thought the system could be usefully applied to carrying minerals on the West Coast, and that the "overhead system" was well adapted for the streets of Hobart.

Mr. J. Fincham, C.E., said he had followed the paper with interest, but they had no reference to the length of the steep grades surmounted. He believed that in any scheme for electrical traction in Hobart this would be one of the difficulties. He was aware that there were about 300 tramways in America, but he had not been able to get any particulars as to the grade, or whether it was equal to such a grade as they had to contend with in going up Elizabeth-street.

Mr. A. W. Lawder, C.E., thought the length of grade to be overcome simply resolved itself into a question of the power of the accumulator.

Mr. Fincham said that was just the difficulty the engineers found. They had not been able to provide enough accumulation to overcome a sustained strain.

Mr. Jones, in reply, said Mr. Fincham appeared to associate the "storage system" with the practical operation of electric trams, but it was clearly pointed out that the "storage" up to the present time was an ideal method, and that the "overhead system" was the only one of practical value. The main defects of the former are the limited capacity of the cells, and when brought to bear on a grade of 5 per cent. heat instead of current was developed, which buckled the cell plates, rendering them useless; and, again, the cells are composed of lead, weighing altogether 3,500lb., which has to be carried about over light as well as the heavy grades, losing 60 per cent. of the available efficiency. Coming to the "overhead system," the question of surmounting heavy and continuous grades resolves itself into a question of increased power, which is always to be obtained from the central station, and herein lies the great advantage the overhead system has over any other. All the available energy can be utilised excepting a few points per cent., due to the resistance of the current by the conductor. The maximum grade in Hobart is 1 in 16, and is slight compared with some of the towns where cars are being operated by electricity. The following is an extract from a letter from the directors of the "Richmond Union Passenger Line" to Mr. Sprague:—"The road which you have equipped under most trying conditions has been one of the most, if not *the* most, difficult which could be met with in street railway work. The excessive and continuous grades, the numerous sharp curves, the gradients in these curves, the weight of the cars, and the heavy loads which they have been required to carry, together with the extent of the system, and the number of the cars in operation (about 40), constitute the enterprise the largest and most difficult yet inaugurated in any part of the world. We acknowledge the successful fulfilment of all the terms and conditions of the contract, and compliment you upon having achieved so signal a success." The number of street electric railways at work, and the number contemplated, is quite sufficient to prove that it has long since passed the experimental stage of development. Citizens of Hobart should keep these facts in view, and refuse to listen to any argument stating it to be impracticable to introduce an electric service here. The wretched apology for a permanent way will certainly have to be removed, and a neat steel-grooved rail put in its place, as the basis of efficient street transit is a smooth and sound rolling surface. I would also like to see a 4ft. 8½in. gauge, instead of a 3ft. 6in. gauge, as the latter might create mechanical difficulties which cannot at present be foreseen, as all the electric roads, or nearly so, are built to 4ft. 8½in. requirements. Of course these difficulties would be overcome; still it is just as well to be on the safe side. As regards a prime source of power for Hobart, it is a simple question of cost and maintenance whether water or steam would be better. There is plenty of water, and the cost to supply a constant head would be, I think, much less than coal. Two hundred h.p. would be more than sufficient force for a service of 12 cars, and as to the mechanical power for equipment it does not make much difference whether the grades be 1 in 5 or 1 in 10, as the motors used are of a standard size, having a capacity of 15 h.p. each. Where the grades do not exceed 4 to 5 per cent, one motor could do the work, but where the grades exceed 5 and run up as high as 10 per cent., then it is unsafe to operate, except by driving both axles, and then the equipment must be two 15 h.p. motors. The average weight for street motors' equipment is about 100lb. per h.p Hence 2·15 h.p. motor equipment will weigh about 3,000lb. I have deduced this to mathematical formulæ following:—H.P.=4·75=M.T. (C x 1), where M=miles per hour, T No. of tons, C rise in feet per 100. The cost of single line "overhead" construction, including permanent way material, under average conditions should not amount to more than £3,500 per mile. This, in comparison with the cable system at Melbourne at £34,000 per mile is very marked, and the economy of the overhead system is so manifest that Mr. Henry Peabody, of Boston, wrote to me as follows, in reply to inquiries:—"There is a feeling among all Municipal Councils, where railways apply for overhead lines, that the increased economy warrants their asking for a decrease of fares, hence their desire to keep quiet about their balance-sheets." Mr. James asked me to explain the Telpherage system. There are two, "the series," and the "cross ones parallel." The latter is now being operated in many places. The skips or trucks are suspended and supported by iron rods, which are likewise supported by poles, and the lower rod, acting as a conductor, is constructed on the "break and make" principle at every 120ft. or so, taking its supply of current from a dynamo fixed at a convenient place. The "makes and breaks" are normally closed, so that a current of electricity may flow from end to end; but when the first wheel of the skip of a train touches the "break," the circuit is closed, and the current runs back to the last wheel of the train, and into the skip containing the motor, and thereby energising the train. The same operation continues at the intervals stated to the end of the journey. It can be worked up to 15 miles per hour with ease, and the cost of carrying is about one halfpenny per ton per mile. Unlike most new inventions, "Telpherage" does not persist in adhering to any principle of an obsolete type, but is an innovation so extraordinary as to pass all practical experience. As feeders to the West Coast lines nothing could be more admirable, and not in the remote future we shall see it universally adopted, instead of those useless unpayable lines and costly roads that cripple the resources of new countries.

NOTES ON THE SHELL-MOUNDS AT SEAFORD, LITTLE SWANPORT:

By Alfred J. Taylor, F.L.S., F.R.G.S.,E.

Among the many interesting relics of the Aborigines of Tasmania that yet remain, not the least interesting are the shell-mounds that mark the spot where they formed their encampments and feasted before the intrusion of a white race had disturbed their simple and peaceful modes of living. Such shell heaps as that to which I am about to refer occur in other parts of the world, and for some time they were supposed to be nothing more particular than ordinary "raised beaches." Even now in Tasmania there are many well-informed people who cannot bring themselves to believe that the shell heaps noticeable in many places on our shores are the kitchen-middens, or "refuse heaps," of the Aborigines of the colony; and it is for the information of such sceptics that I place on record the following evidence as establishing beyond all reasonable doubt the fact that they are this, and nothing more. One has only to examine these remarkable accumulations to obtain evidence of an intensely interesting and convincing character, and the results of a personal examination of the extensive shell mounds to be found on the estate leased by Mr. Samuel Drake at Little Swanport have induced me to hope that a few notes on the subject may be of some interest to the Fellows of this Society. It may be as well, I think, to prelude what I have to advance as direct evidence in favour of my contention by briefly referring to one or two of the reasons why the accumulation of shells at Little Swanport cannot be regarded as having been due to the upraising of oyster beds, or as having been due to the wash of surf upon the spot. In the first place, although it can be shown that at some places where shell mounds occur in the colony live and dead shells are thrown up by the surf, at Little Swanport there is no wash or surf to cast up shells, for while the plunging seas roar on the bar outside, the waters within are, as a rule, as still and as peaceful as the waters of a mill pond. The conclusion that the shell beds have been upraised from the sea is disposed of by the natural features that distinguished true raised beaches from kitchen-middens or refuse heaps. Sir John Lubbock, in his "Prehistoric Man," has drawn attention to the fact that raised beaches contain species the individuals of which are of different ages, and that the shells are, as a matter of course, mixed up with a large amount of sand and gravel. He also quotes Professor Steenstrup, who, in combating the idea that the shell mounds of Denmark were raised beaches, directed attention to the circumstance that "the shells belonged entirely to full-grown or to nearly full-grown individuals, and that they consisted of four species which do not live together, nor require the same conditions, and would not, therefore, be found together in a natural deposit; and thirdly, that the stratum contained scarcely any gravel, but consisted almost entirely of shells" (pp. 224-5). This reasoning applies exactly to the shell mounds at Little Swanport: for not only is there an absence of anything like stratification or admixture of much sand or gravel with them, but the whole of the oyster shells that have come under my notice are of mature growth, and are mixed up with other species that do not live together. In connection with this negative evidence I may throw out the consideration that if these deposits were merely the indications of an upraising it would only be reasonable to anticipate that many of the shells would be found in natural pairs. Such, however, is not the case at Little Swanport, the shells that I noticed during my recent visit to that very pleasant and interesting spot being, in every instance, single shells scattered just as we might expect to find them in refuse heaps. Another noticeable feature in the mounds at Little Swanport is the fact that a very large proportion of the shells are broken at one particular part, as if they had been broken there to assist in the process of opening them. It is also noticeable that many of them have undergone the action of fire. To turn to the more direct evidence. The encampments of the Aborigines were always formed on the margin of streams or lagoons. Possessing no appliances for digging or sinking wells, it was a matter of importance to them to be near fresh streams or springs. On the spot where the shell mounds are thickest, at Little Swanport, there is a splendid fresh water spring, which bubbles up within a few yards of the bay, yielding a plentiful supply of the sweetest fresh water. Their place of encampment depended also upon the food obtainable, and as the daily food of those living near the Coast consisted largely of shell fish, such as oysters, turbos, and haliotis or mutton fish, they would naturally resort to such a favoured spot as Little Swanport, where these, together with the crayfish, another article of their diet, could be found in abundance. As a matter of history, it is known that a very large tribe of natives, known as the Oyster Bay tribe, frequented the spot, and during my recent visit to it I was able to discover some very interesting indications of the primitive conditions under which they existed. When I first decided to turn the shell heaps into lime of commercial value, it struck me that many articles of ethnological interest might be discovered, and I gave strict instructions to the parties employed to send me all bones or remarkable stones that they might come across in breaking down the shells for the kiln. It was not long before I had the pleasure of receiving a parcel of bones—the remains of the marsupials the natives used to feed upon—and I at once noticed that the larger ones had been split, evidently for the purpose of extracting the marrow. At a meeting of the Royal Society of Tasmania in 1873 Mr. James Scott volunteered certain information received from his brother, Mr. Thomas Scott, who, among other things, referred to a stone which he had sent to England—"A round stone chipped all round to a circle about 7in. in diameter, and 1½in. thick in the centre, to 1in. at the edge. On this the females broke the bones of animals for the marrow, using another stone about 6in. in diameter for striking." I am able to exhibit a stone exactly answering this description, which I took from the surface of one of the shell-mounds. It will be noticed that at the middle part on one side it has been worn smooth by the friction of use. I also found mixed up with the shells other round water worn stones, evidently used for the same purpose; for in the Transactions of the Ethnological Society for 1863 there is a statement made by Mr. Milligan to the effect that the Aborigines had assured him that round stones of different sizes, together with chipped flint instruments, would be found in the shell-mounds left on the scenes of their feasts. Bearing in mind the latter portion of this statement, I was very anxious to find some of the chipped flints, and made a careful examination of the surface of the shell-mounds. You may imagine my delight when my eye rested on a well marked one which had been turned up in ploughing. Further examination led to the discovery of several others of the same character. But I was not yet satisfied, as I had found them all upon the surface. Being anxious to test the extent of the shell deposits, I got my companion, Mr. W. Luttrell, to put down a few prospecting holes, and in sinking one of these we came across a well-chipped flint, buried in the shells some 12in. below the surface. There is one significant fact in connection with the bones found in these shell-mounds, and, indeed, with the shell heaps alone, and that is the constant occurrence of charcoal—the remains of the fires kindled by the natives to roast the animals and to cook the shell fish "in their own gravy." It is known that to do the latter the large shells were placed upon the fire as dishes, and that this method of cooking rendered the contents tender and succulent. The presence of the charcoal under such circumstances affords another link in the chain of evidence that bears out the certainty that these shell-mounds are something much more interesting than upraised beaches or oyster beds. Perhaps the most interesting of the "finds" yet made in connection with the shell-mounds at Little Swanport has been the discovery of a bone (which I now exhibit) which gives evidence of having been worked or ground. As far as I know it is the first bone instrument of the kind that has yet been referred to in connection with the history of the Aborigines of this colony. It was discovered by Mr. Herbert Luttrell in breaking down the shells from one of the faces opened to supply the kiln. Mr. Ronald Gunn has stated that in removing haliotis or mutton fish from the rocks to which they closely adhere the natives used a wooken spatula-shaped instrument, and Backhouse writes that the mutton fish were often taken in deep water by the native women, who dived for them and forced them off the rocks by means of a wooden chisel. The French explorer, La Billardiére, saw how these chisels were made. "We observed," he writes, "some of the savages employed cutting little bits of wood in the form of a spatula, and smoothing them with a shell, for the purpose of separating from the rock limpets or sea-ears on which to feast." I think it quite probable that the bone instrument before us was used for a similar purpose. On examination it will be found that it is somewhat worn just at the spot where it would be most likely to show the effects of friction if used to work and lever the sea-ear from the rock. In any case it is interesting, as indicating one step towards a degree of civilisation that the Aborigines of the colony were destined never to reach. In putting down the prospecting holes above referred to I satisfied myself that the shell deposits at Seaford extend over several acres of ground, varying in depth from 6in. to 6ft. It is the vast extent of these deposits that renders it almost impossible for anyone at first blush to realise that they are the refuse heaps of the Aborigines. When it is remembered, however, that the tribes near the sea-shore lived principally on shell fish—for, according to Calder, and other authorities, the natives of Tasmania would rather have starved than use any kind of scale-fish for food—it will easily be seen that large refuse heaps would very rapidly accumulate on the feeding grounds. The best authorities agree that the natives were very ravenous eaters, and setting the number of the Oyster Bay tribe at 500 (an estimate I have heard given), and putting down to the account of each member of the tribe a consumption of 20 oysters per day, that small calculation alone would give 20,000 single shells per day to the refuse heaps. There is one thought in connection with this matter with which I will conclude my somewhat desultory notes. Lubbock has pointed out that—"A country, the inhabitants of which live by hunting and fishing, can never be thickly populated." Regarding the shell-mounds at Little Swanport in the light of this fact, and taking into consideration their vast extent, the conclusion is forced upon us that the spot must have been frequented by the natives for a very long period of time, and this is a fact that should not be lost sight of when efforts are being made to trace their history and origin. It now only remains for me to mention that we are about to turn these interesting shell-mounds into a valuable article of commerce, and should anything of interest be discovered during their removal, it will give me great pleasure to make the Fellows of this Society acquainted with the fact.

DISCUSSION.

Mr. R. M. Johnston said he was very pleased to find Mr. Taylor had taken so much trouble in obtaining such valuable information dealing with the Aborigines of Tasmania. The paper read by Mr. Taylor was extremely interesting from an ethnological point of view. He, Mr. Johnston, had made a close study of these native "kitchen middens" for many years, and in his work on "The Geology of Tasmania" he had devoted a considerable space to the description of these interesting deposits so common along the borders of our estuaries and coasts. The particular shell deposit at Little Devonport, referred to by Mr. Taylor, had been investigated by him about two years ago, and his observations then made, in company with Mr. Morton and other members of the Fishery Board, left no doubt in his mind that the deposit was simply one of the many kitchen middens of the Tasmanian Aborigines abounding everywhere along our coast lines in similar situations. The lenticular layers of ashes and charred wood, intercalated with the shells, were then observed by him, and pointed out to those who were with him as proof of their accumulation by human agency. He could therefore confirm the accuracy of Mr. Taylor's descriptions and conclusions. Anyone who has had the slightest experience in observing these interesting deposits, now fast disappearing or being obliterated by the agriculturist's plough and other agencies, would never confound them with the raised beaches so common in Bass Strait Islands and along portions of the northern coast.

Mr. Johnston then drew attention to the numerous kitchen middens existing all along the borders of the estuary of the Derwent, and especially along the Domain, New Town Bay, mouth of the Jordan, One Tree Point, and Blackman's Bay. These are generally formed on little knolls or headlands, commanding a good outlook on every side. One interesting mound exists high up on the Domain, near the New Cricket Ground. From all of these he had collected the chipped flints, and occasionally split bones of the wallaby. Over 150 chipped flints had been collected by him from these deposits near Hobart, and a very large number had recently been sent to him, collected by Mr. John Morrisby on the borders of Pipeclay Lagoon, South Arm.

He stated also that he had recently received a communication from Mr. Mitchell, of Lisdillon, who tried upon the basis of the extent of these shell deposits to make some estimate as to the length of time during which the Island was occupied by the last Tasmanian race. Mr. Johnston stated that an estimate formed in this way would be very unsatisfactory, as the kitchen middens are formed for the most part on the marginal boundaries of our seas and estuaries, and are constantly being encroached upon by the great invader, the sea. It is evident therefore that the horizontal encroachment of the sea would have destroyed the very earliest deposits, supposing them to have existed. It is almost certain from ethnological considerations that the Tasmanian Race must have existed in Tasmania for a very long period, for otherwise how can we account for the marked racial type as compared with the natives of the Australian mainland and elsewhere.

REPORT

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OF

TASMANIA

FOR THE YEAR

1891.

Tasmania:
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* Fellows who have contributed Papers which have been published in the Society's Transactions. † Denotes Life Membership.

The addresses of Fellows residing in Hobart are omitted.

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Murphy, Most Rev. D., Archbishop of Hobart

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* Nowell, E. C.

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Sharp, John
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Young, F. J., B.A.
Young, F. M., B.A.

MINUTES of the Annual General Meeting of the ROYAL SOCIETY OF TASMANIA, *held at the Royal Society's Rooms on Tuesday evening, 5th April,* 1892,—JAMES BARNARD, *Esq., Vice-President, in the Chair.*

THE following gentlemen were elected Corresponding Members:—Messrs. A. Sydney Oliffe, Government Entomologist, N.S.W.; G. M. Thomson, F.L.S., Principal of the High School, Dunedin, N.Z.; J. Shirley, B.Sc., of Brisbane, Queensland; W. M. Hamlet, F.C.S., F.I.C., Government Analyst, Sydney; Professor W. Bragg, M.A., of the Adelaide University; T. W. E. David, F.G.S., of the Sydney University; W. Baldwin Spencer, M.A., of the Melbourne University; and Dr. A. Dendy, D.S.C., Melbourne University.

The following persons were elected Fellows of the Society:—John Deans, M.D., Miss May Dickson, the Rev. Herbert R. Finnis, and Messrs. Henry H. Anderson, B.A., and John Goodall, C.E.

REPORT.

The Council of the Royal Society of Tasmania have much pleasure in submitting the following Report for 1891.

The first monthly meeting took place on April 22nd, when the President, His Excellency Sir R. G. C. Hamilton, K.C.B., occupied the Chair, there being a good attendance of Fellows, Lady Hamilton and several ladies being also present. Mr. A. Morton, who, in conjunction with Mr. C. H. Grant (then absent from the Colony), had been appointed as Delegates from the Royal Society to the third meeting of the Australasian Association for the Advancement of Science held at Christchurch, New Zealand, in 1891, gave an interesting account of their proceedings, reporting that Hobart had been fixed as the next place of meeting, and that His Excellency Sir R. G. C. Hamilton had consented to fill the important office of President.

Six meetings of the Society have been held, that of November having been postponed owing to the near approach of the Science Congress in January. All the meetings had been well attended by the Fellows.

Thirteen papers have been read, on many of which interesting discussions took place. His Excellency had been present in the Chair on all occasions. The subjects of the papers read were:—

By H. H. Montgomery, D.D., Bishop of Tasmania.

1. "Account of the Mutton Birds or Sooty Petrels, as seen in their homes among the Furneaux Islands, Bass Straits, Tasmania."

By R. M. Johnston, F.L.S.

2. "Notes on a Collection of Plant Impressions from the Henty River."

3. "Observations on the Causes of Elevation and Subsidence of the Earth's Crust."

By Baron von Mueller, K.C.M.G.

4. "Remarks on some Rare Tasmanian Plants."

By A. B. Biggs.

5. "The Possibilities of the Telescope."
6. "Total Eclipse of the Moon, May 24, 1891."
7. "The Transit of Mercury, May 10, 1891.'

By F. Danvers-Power, F.G.S.

8. "Notes on the Mount Lyell District, No. 1."
9. "Notes on the Mount Lyell District, No. 2."

By F. J. Jacobs, A.T.A.

10. "Note on the Arithmometer as an aid to Actuarial Work."

By W. Spencer, M.D., M.R.C.S. Eng.

11. "Hypnotism and alleged Phenomena."

By A. J. Taylor, F.L.S., F.R.G.S. Eng.

12. "Notes on the Shell Mounds at Seaford, Little Swanport."

COUNCIL.

No change has taken place during the session.

LIBRARY.

The most noteworthy circumstance in connection with the Library has been the completion of the rare and expensive work "The Birds of Asia," by J. Gould, F.R.S., the remaining 23 parts being a munificent gift to the Society by the Hon. J. W. Agnew, M.D.

FELLOWS.

Six Fellows and two Corresponding Members have been elected; twenty have been lost through resignation or death. The hearty congratulations of the Council were, during the session, given to Mr. James Barnard and the

Hon. Dr. Agnew, who in May celebrated their jubilee as Members of the Royal Society of Tasmania and its precursor, the Tasmanian Society for Natural Science.

FINANCE.

The income has been :—Subscriptions to Royal Society, £175; fixed deposit, £208; interest, £10 18*s*.; total, £393. Expenditure, £235 1*s*. 1*d*.

In moving the adoption of the Report the Chairman stated that the meeting would have been held in January but that the meeting of the Australasian Association for the Advancement of Science took up the whole of the time of those engaged. The Society had met with great success, for which the thanks of the Members were due to the liberality with which their requests had been met by the Parliament of Tasmania. The Municipal Corporation also deserved thanks for the manner in which they had given space at the Town Hall to hold the lectures in. The Committee had used almost superhuman exertions to make the affair a success, and from the results which had attended the labours of those engaged there was no doubt but that the whole had been a most undoubted success.

Mr. C. H. Grant seconded this, which was carried.

Votes of thanks were moved by Mr. C. Belstead and seconded by Mr. C. H. Grant, to the Auditors for the work carried out by them during the past twelve months, they being re-elected to fill that position; and by Mr. A. Morton, seconded by Mr. C. H. Grant, to the Press as follows :—" That a vote of thanks be accorded the Press for its valuable services in promoting the objects of the Royal Society by its ready and accurate reports of the evening meetings, and in various other matters,"—both of which were carried unanimously.

Mr. Morton, in moving the above, spoke in feeling terms of the services rendered by the late Mr. J. Johnson, formerly a member of the reporting staff of *The Mercury*. The seconder and the Chairman also endorsed the remarks made by the Secretary, after which the meeting terminated.

STATEMENT of the Funds of the ROYAL SOCIETY *for Year ending* 1891.

Receipts.	£	s.	d.	£	s.	d.
Balance from 1890	28	12	0			
Fixed Deposits	208	0	0	236	12	0
Subscriptions	...			175	10	0
Refund Weaver's Cheque	...			1	1	0
Interest on Fixed Deposit	10	18	0			
Ditto	10	8	0	21	6	0
Bank Balance per Pass Book	5	19	1			
Credit	0	5	0			
Interest drawn in error	6	4	1			
Outstanding cheques £9 6*s.* 8*d.*; £15 17*s.* 6*d.*	25	4	2	19	0	1
				£453	9	1

Expenditure.	£	s.	d.
Salary of Secretary	50	0	0
Ditto Attendant	6	0	0
Current Expenditure	179	1	1
Fixed Deposits	218	8	0
	£453	9	1

Examined and found correct.
JOHN MACFARLANE.
FRANCIS BUTLER.

29th March, 1892.

STATEMENT of the Funds of the MORTON ALLPORT MEMORIAL FUND *for the Year* 1891.

1891. Dr.	£	*s.*	*d.*	Cr.	£	*s.*	*d.*
Balance as per statement for 1891	68	1	4	Purchase Buller's "Birds of New Zealand"	13	13	0
Interest	2	14	6	Balance in Savings Bank to credit of Fund	57	2	10
	£70	15	10		£70	15	10

Examined with Savings Bank Book, and found correct.

JOHN MACFARLANE.
FRANCIS BUTLER.

29th March, 1892.

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.

PAPERS AND PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

TASMANIA,

FOR

1892.

(ISSUED JUNE, 1893.)

TASMANIA:
PRINTED AT "THE MERCURY" OFFICE, MACQUARIE ST., HOBART.

1893.

The Responsibility of the Statements and Opinions given in the following Papers and Discussions rests with the individual Authors; the Society as a body merely places them on record.

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ALEXANDER MORTON.

* **Members who next retire in rotation.**

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ROYAL SOCIETY.

APRIL, 1892.

The first monthly evening meeting of the session of the Royal Society was held at the Museum on Tuesday, April 12. Mr. C. H. Grant presided. An apology for absence was received from His Excellency the Governor, Sir R. G. C. Hamilton, K.C.B., LL.D., President of the Society.

NEW MEMBER.

The Secretary (Mr. Alex. Morton) introduced a new member of the Society, Mr. John Goodall, civil engineer.

BOTANY OF TASMANIA.

The Secretary said that Mr. Leonard Rodway was preparing a "Handbook of the Botany of Tasmania," which he wished to bring out under the auspices of the Society. Mr. Rodway was present, and would explain the purport of his work.

Mr. Rodway said they had never possessed in Tasmania a really complete handbook of the flora of the colony. They had Hooker's work, certainly, but it was too expensive for the ordinary public. The only other work was one including the whole of the flora of Australia, which had the same drawback. The late Mr. Spicer brought out a handbook, but it was really little else than a key to the works mentioned, and was now out of print. It was so painfully artificial that in order to work a plant out by it the student must be possessed of the first-mentioned publications. When he first took up botany here he found there was a necessity for a handbook; and on mentioning the fact that he was thinking of compiling one during the meetings of the Australian Association for the Advancement of Science several members urged him to go on with it at once. He had prepared a certain portion of the work, an eighth or tenth portion of the whole manuscript. In what he had prepared there were 190 species dealt with, which was about one-fifth of the whole in Tasmania. The plan of the work was similar to that adopted by Bentham in the "Flora of the British Isles." The work would be divided into two volumes, and in the event of the Society taking it up, the first volume could be published in twelve months, and the second two years thereafter. He had done all he could to avoid technicalities in preparing the work. What he would suggest was that the Council of the Society would look over the portion he had drawn up, and tell him whether, provided he produced the manuscript according to their suggestions and their satisfaction, they would support its publication.

The Chairman said he had no doubt the Council would be willing to assist in anything of that kind. He thought it would be a waste of labour, however, to add to the proposed work an introduction on elementary botany, but he thought a handbook of the flora of Tasmania would supply a much-felt want.

Mr. Rodway said what he proposed to do was to refer the student to certain handbooks, and not exactly supply an introduction on elementary botany.

The Secretary pointed out that a work like Mr. Rodway's could not be published at the expense of the Royal Society, but the Royal Society might take it in hand, and approach the Government and get it published under similar conditions as Mr. R. M. Johnston's valuable work, entitled, "The Geology of Tasmania." No doubt the Government would recognise the importance of this work as they did with that of Mr. Johnston, and make provision for its publication.

The part of the work prepared by Mr. Rodway was remitted to the Council of the Society for their consideration.

TASMANIAN APPLES IN LONDON.

Mr. W. E. **Shoobridge** read a paper entitled "Tasmanian Apples in London." He said :—The export of Tasmanian apples to London opens up a wide and interesting field of inquiry to the student of physical science, as well as a source of profit to Tasmanian growers, and pleasure to consumers in England, and being intimately acquainted with the subject from the beginning, he had thought some account of its history would be interesting to this Society, and form a record of the initial steps taken to establish what now appears likely to be of colonial, if not national, importance. The soil and climate of Southern Tasmania have long been noted for their suitability for growing and maturing all the fruits of a temperate climate in perfection; and as the industry gradually extended from Hobart, southwards to the Huon, and north-westerly up the Derwent Valley, a distinct difference was discovered in the growth, and consequent treatment necessary in the two districts. In the Huon the heavy rainfall and damp climate, and fertility of virgin soil fresh won from the dense forests produced a luxuriant growth of large sized fruit, and orchards quickly spread along the narrow valleys and crept up the steep hillsides until it became the staple industry of a great part of the district, and the main dependence of a number of small settlers. The Derwent Valley extending inland, and gradually widening in a north-westerly direction out of the line of the great mountain ranges of the west that cause the moist climate of the Huon, is dry and arid, and the system of fruit growing, especially that of apples, that had been so successful in the Huon, failed when applied to the Upper Derwent. But small patches of the river flats near New Norfolk that received the drainage from the hills, and some that were irrigated for hops, were found to produce excellent fruit; through information about irrigation and its effect on growing and maturing fruit was difficult to obtain, and such knowledge as could be gained by fragmentary description of Indian and Italian irrigation, needed adapting to the special wants of our own soil and climate. Besides a strong though unreasoning prejudice existed against fruit grown by artificial watering, as it was said to be soft and green, though large, and destitute of flavour and keeping qualities, and at the same time irrigation appliances were costly and hard to get. But the indomitable energy of the Anglo-Saxon, when once fairly applied to the problem, slowly but surely overcame the difficulties, and brought success out of seeming failure. The first step was to get an accurate knowledge of the climate, and this was obtained by a careful series of observations, extending over many years, by which it was found that the average rainfall at New Norfolk for the year was 23·22in., and the spontaneous evaporation 45·36in.; and for the summer months of December, January, and February the mean average rainfall was 5in., and evaporation 15in , the mean temperature of three daily registers, 62·36deg., the mean of maximum solar intensity 134·88deg., of minimum terrestrial radiation 41·51deg., and humidity of air ·68 per cent.; of course this means an exceptionally dry summer climate for cultivation, and explained the reason of the failure of the Huon system when applied to the Derwent, but the mean amount of cloud of three daily registers (7·30 a.m., 4.30 p.m., and sunset) was only 4·20 of scale 0—10. He gave these and other figures in order that those who may wish to investigate the subject, either as a matter of inquiry, or for the purpose of establishing the industry in other places, may have some reliable data to go on. The next step was to find out the effect of water on the growth and maturing of the fruit, and after a patient and extensive series of trials, with nearly 100 varieties of apples, on different soils and situations, and varying amounts of water, applied at all stages of growth, as well as the effect of many systems of pruning, manuring and cultivation it was found that the water principally acted as a carrier or medium, by means of which the plant was fed, and the action of growth, consisting as it does of a constant absorption of water by the roots, carried up to be exposed to the sun and air, and by the action of the chlorophyll cells, the hydrogen of the water combining with the carbon dioxide in the air, forms the series of hydrocarbons, that are the basis of all plant life, and by the addition of the salts and acids held in suspension by the water from the soil, and acted on by heat and light, causing the chemical changes and combinations that build up the different parts of the plant, and mature the seeds and their covering, that is, the fruit. It was found, that given a sufficiency of moisture in the soil to dissolve the chemical matters contained in it either naturally or artificially supplied when wanting, the essential point was to ensure a free circulation of air and access to light, of every part of the tree and fruit, and also to aerate the soil by constant moving, so that the roots could have air as well as water. The amount of water required to do this in the friable loam of most parts of the Derwent Valley, was found to be 30in. for the three summer months, and as the absence of cloud meant more sunshine, the dryness of the air was a positive advantage in maturing and colouring the fruit, as when a free growth was kept up by the constant artificial supply of water, the maturing was hastened, and as the fruit was more fully developed, the flavour and keeping qualities were vastly improved. The accuracy of these observations is confirmed by the researches of Dr. Julius Von Sachs on the transpiration of plants, which show that when it is increased by light and heat in a dry air, the passage of water from the soil is hastened, and by its evaporation in the stomata of the leaves, more of the salts in suspension are left in the chlorophyll cells, and consequently there is a rapid increase of the substance of the plant. The effect of this system, varied with the sort of apple and method of pruning, and finally the sturmer pippin, scarlet nonpareils and French crab were selected as the most suitable varieties, as well as being the healthiest trees and heaviest, and most regular croppers, and by their firmness of flesh and toughness of skin, best adapted for the rough usage of travelling. Of these the sturmer pippin is most improved by watering. It is satisfactory to find that these three sorts are pronounced by experts in the London fruit trade to be the best in flavour and appearance to please English customers. The style of preserving known as the inverted pyramid, formed by a number of branches radiating from the stem, a short distance from the ground, was found the best shape to allow free access of light and air to every part, as well as easiest to pick and prune, and least liable to damage from wind. Having selected the apples and learnt the best method of growing, the next difficulty was in transport. A six or seven weeks' journey, part of which was through a climate absolutely destructive to the apple, seemed at first an insuperable obstacle, but by the same method of patient observation and experiment, aided at last by the co-operation of growers, the dangers to avoid were gradually found out, and a knowledge was gained of the conditions necessary for the successful transport of fruit to London. First of all experiments were made ot the amount of heat apples could stand without injury, and it was found that 70deg. was about the limit of safety, but the heat of the tropics, both in water and air, averages about 90deg. for 10 to 14 days of the voyage, so artificial cooling was a necessity. The success of the dry air refrigerating process for carrying meat naturally led to inquiries to see how far it could be utilised for carrying fruit. A serious difficulty existed in the fact that the fruit season lasting so short a time meant that only a single trip of each steamer in the year was available for the trade, and the fruit being so susceptible to taking up foreign flavours, as well as liable to damage other things, no other article could be carried in the same hold, so freight could only be secured by guaranteeing to fill the whole of the cool chamber in each boat carrying fruit at the high rate of 90s. to 100s. per ton freight, growers taking all risks. The knowledge gained by so many years of patient inquiry and experiment had established the following facts:—1st. That at least three kinds of apples of excellent flavour, appearance and keeping qualities could be produced in greatest abundance and perfection, especially in the Derwent Valley district, and that the supply could soon exceed the demand of colonial markets. 2nd. That an almost unlimited market existed in England for this class of fruit, and owing to the difference in season, could be landed in London at a time of year when it would not have the competition of either home grown or American growth, and consequently good prices might be expected for the quality of fruit produced here. 3rd. That the fruit would keep in good order for at least double the time required for the voyage, provided the right condition of temperature and ventilation could be secured. 4th. That the yearly increasing number of ocean steamers fitted with cooling apparatus provided the means whereby a very large quantity of fruit could be carried. It now became necessary to secure the co-operation of growers, so that a sufficient number of cases could be collected to fill the cool chambers of some of the ocean steamers. By this time growers had so much confidence in the knowledge gained as to induce them to risk enough fruit to make the experiment. Accordingly in 1888 the first shipments on a large scale were made, although small experiments in shipping had been made for many years with varying success, and it was thought if they could only be kept cool enough through the tropics, there would be little danger in the venture. These first large shipments, however, only served to show the number and magnitude of the difficulties. In the first place the refrigerating machinery was designed for carrying meat, the essential condition of which was that it should be kept below freezing; but freezing was ruinous to apples, and some cargoes were nearly all spoilt by this cause and even when saved from frost the great amount of condensation of cold air from machine coming in contact with the damp air in the hold was very injurious, and in addition to this the want of proper ventilation in parts of the hold favoured a fungoid growth that spoilt the flavour even when it did not cause rot, and the rough handling of the fruit by stevedores unaccustomed to such easily bruised articles, was, and still is a serious loss, as the short time allowed for the loading makes careful handling very difficult. Improvements are gradually being made in tempering the air entering the cool chambers to prevent freezing and excessive condensation, and in thoroughly ventilating every part of the hold to prevent mould; and a new system has been proposed, adapted for ordinary holds, by fixing an exhaust fan to draw the air from every part of the hold by a reticulation of fixed pipes, and passing the inlet air through a chamber (supplied with cold air from the refrigerating machine) by a series of small pipes, so as to cool the air in passing through, and also to condense the moisture in the air before coming in contact with the fruit. It appears probable that the fungoid growth found in the holds on some of the fruit is anaerobic, and therefore fresh air should be constantly passed through all parts of the fruit to prevent its growth. It is found that the fruit when landed in London is very much riper than similar fruit kept till the same time in Tasmania; this cannot be caused by temperature alone, as the records of temperature of holds are almost identical with recorded observations in Tasmania for same time, viz., 35deg. to 65deg., and is probably due to a certain fermentation set up in the fruit by the natural process of decay, induced or at least accelerated by the fungoid growth found in the holds, and it is on these points that further information is required, viz., 1st. The amount of fresh air required daily by the fruit. 2nd. The range of temperature necessary for safe carriage. 3rd. The cause of fungoid growth in holds. 4th. The cause of premature ripening. 5th. The means by which these fungoid growths and fermentation may be prevented, and ripening of fruit in holds be retarded. It is known in a general way that fruit will not keep as well in a close room as when it is freely exposed to fresh air; that it will endure a range of from 35deg. to 70deg., if changes are not too sudden; that fungoid growths are promoted by a close, damp air; and that when kept in a close room at an even temperature of, say 45deg. to 55deg., it ripens and rots far quicker than in the open. As yet, however, we have not sufficiently accurate information on these points to say definitely how much fresh air and how low a temperature is necessary to carry fruit in the best possible condition, and it is a slow and costly process to acquire it, because, as stated before, only one trip in the year can be taken by each steamer and the experiments have to be made on such a large scale to be of any value; for instance, to test the cool ventilation in ordinary hold will require from 15,000 to 20,000 cases in a single vessel, and it is only by carefully noting the cause of failure that we can find out and apply a remedy. This was notably the case with ventilation. Experiments on a large scale were made in storing fruit in cellars and specially constructed stores, and it was found that the quantity stored in one bulk materially altered the results, and the conditions on the voyage were so different from those in Tasmania, that fresh precautions were needed on shipboard to those on shore. By the willing aid and co-operation of the chief engineers of the different steamers, much has been learnt. For instance by a careful register of thermometers in all parts of the holds it was found that through want of ventilation great differences existed, as much as 28deg. in a distance of 7ft. 6in. apart, and by carefully watching the condition of the fruit as it was unloaded from the different parts, it was found that at the inlet pipes of cold air to hold the fruit was mostly damp and sometimes frozen, and near the outlet pipes it was dry and in excellent condition, whilst in places round the bottoms a damp and mouldy appearance proved the stagnant state of the air. In this latter case the fruit had lost its fine flavour, and although clean and bright in appearance, was comparatively valueless. In spite of all failures and difficulties, it is satisfactory to note that a large amount of success has attended the venture; out of 130,000 cases sent in 1891 to London, at least 110,000 cases of excellent fruit were landed in good order, and was duly appreciated by English consumers of all classes, from Her Majesty the Queen—who was graciously pleased to accept a sample—to the humble customers of Whitecross-street costermongers. Although not of strictly scientific interest, it is yet important to notice the method of sale and distribution, about which much misconception appears to exist. It must be remembered that in this trade we cannot have everything our own way; as it is only comparatively small and intermittent, we cannot have ships specially fitted with machinery and appliances solely for fruit, but must make use of what is already provided with such alterations and modifications as our experience may suggest, and we can persuade steamship companies to adopt; so in the sale and distribution of fruit in England. We find an immense organisation reaching to every part of the country in active work, controlled by a few large firms of brokers in London. It would be quite impossible, for so short a time as we require it, and for a single article, to organise any system that could attempt to deal with the business as it can be done by the existing method; but, as in the case of transport, we may, by careful observation and experiment, see how far we can make use of this organisation to dispose of our fruit with the best results to ourselves. With this object we have established an agency in London, to reduce expenses, to control sales, to find out so as to prevent or make claims for all damages, and generally to exercise a supervision on behalf of growers.

Discussion on this paper was postponed till next meeting.

The Secretary read a paper contributed by Mr. J. Shirley, B.Sc., of Queensland, a corresponding member, on "A list of the known lichens of Tasmania," and one by Mr. A. T. Urquhart on "Some Tasmanian spiders," from a collection supplied by Mr. A. Morton, curator of the Tasmanian Museum. The other papers on the agenda were held over till next meeting.

The CHAIRMAN proposed a vote of thanks to the gentlemen who had contributed papers, which terminated the proceedings.

MAY, 1892.

The monthly meeting of the Royal Society of Tasmania was held at the Museum on Tuesday, May 11. His Excellency the Governor Sir R. G. C. Hamilton, K.C.B., LL.D., presided. There was a good attendance of Fellows.

His EXCELLENCY expressed his regret at being absent from the last meeting. This was the first time he had been with them since the late Science Congress had met, and he congratulated them upon the success which had attended their labours in this respect. This was, he was sure, largely due to the exertions of Mr. A. Morton, the General Secretary, who had been indefatigable in his efforts to make the affair a success. Mr. Ogilvy had thrown out a very valuable suggestion, to which reference was made in his address at the meeting of the Science Association. The idea was that they should have corresponding members stationed in various places. The country should be mapped out into districts, and each separate district be recognised as being under certain persons' observations, who would undertake to forward anything of any importance which might come under their notice in their particular districts. They might also be communicated with at will upon the subject, and inquiries instituted. He would like the matter to be discussed at the next meeting of the Society. Perhaps they might think the matter over, and make preparations for the discussion in the meantime. He then invited discussion [upon the paper of Mr. W. E. Shoobridge.

Mr. A. MORTON said that the suggestion of Mr. Ogilvy was bearing fruit already. He had received a number of specimens from different parts of the island. One was a specimen of a very large crane (*Ardea pacifica*) seldom found in Tasmania, although common in Australia. Another was a white crane (*Herodias alba*) also scarce here. A duck, hitherto unrecorded in Tasmania, called the "blue bill" (*Erismatura australis*) was also sent. The Australian coot was another species of bird rather scarce in Tasmania, and recently found here in some plenitude. He was at a loss to account for the influx of these birds into the island at this period.

His EXCELLENCY stated that he had observed that the crane species were unusually plentiful this year.

THE EXPORT OF APPLES.

Mr. C. H. Grant, with reference to Mr. Shoobridge's paper upon the export of apples to Europe, said that the author of the paper had dealt with the question in a very able manner, although it was rather deficient in the details relating to the cultivation of fruit, which, however, might possibly relate more to the gardening industry than to the Royal Society. The paper itself could bear a great deal of argument. He was not in a position to criticise it for it carried a great deal of information, and contained matter of interest. From a scientific point of view it was invaluable. In the earlier days of fruit-growing there was a great amount of labour wasted, and money expended in cultivating the wrong kind of fruit. It was always a matter of interest to study the products of the soil, and he was sure the Society was much indebted to him. Mr. Shoobridge had also given some valuable information concerning his meteorological surveys, in which he was a pioneer. They were all, he was sure, greatly pleased with the efforts of Mr. Shoobridge in the researches he had made, and for the valuable information he had furnished.

Mr. W. E. Shoobridge said that there were two points which were very necessary to discuss on the subject; one was the question of irrigation, and the other the effects of the atmosphere upon the growth of fruit. The finest fruit he had ever seen was grown in a dry atmosphere, where the trees had been well irrigated. The reason for this was that the trees required as much light and air as possible. The water acted as a carrier of soluble salts, necessary to the life of the trees. The more sunlight and air that was received by the trees the greater and more active were the chemical changes, and the higher products of the plant. The gums, resins, and sugars were more abundant. It was impossible to get this in a moist atmosphere. The French crabs usually grown in a moist atmosphere were, when grown in a dry, airy locality, completely changed in colour. This was very apparent in trees which were grown within a short distance of each other. They also had adopted a new system of pruning. In this climate the full benefit of the sun without too much strength was received, which was of the greatest value. The damage to the fruit in keeping was the result of a fungoid growth produced by the fruit being stored in places where the air was foul. To keep this under it was necessary that the fruit should have a clear current of air. In an atmosphere of 40deg. to 50deg., which was about the proper temperature to keep fruit in, with a clean dry atmosphere, the fruit would keep well. In some of the fruit which had been packed to London a blue mould appeared about the specimens, and on tasting it its flavour was found to be entirely gone. This fungi, which began usually about the region of a bruise, caused immense harm to the fruit, and completely spoiled its flavour. This was never found in the packed fruit near the outlet, because there was a complete current of air. In the places where the fruit was affected the air was very foul, so foul in fact, that in some cases a candle would not burn. It was therefore apparent that the fungi was nourished in stagnant air, and, if information could be gained with regard to this matter, a great step towards the knowledge of the proper course to be dopted for the preservation of fruit would be gained.

His Excellency thought that if information was sent in from various districts respecting the question of irrigation, and how it was applied, it would be of great value. He asked if there were many districts where irrigation was carried on?

Mr. Shoobridge replied that there were not very many, although the question was receiving more attention lately than formerly. There were a great many districts where irrigation was not required.

His **Excellency** thought that it was a pity if the subject should stop at that place. If Mr. Shoobridge would confer with Mr. Morton a series of papers on the subject might be prepared, and if communication were established with different fruit growing districts information might be obtained of much value.

The meeting adopted the suggestion as a favourable one.

Mr. **Grant** said that in his researches he had noticed that in places where fruit had grown to extraordinary proportions, like the district of Nova Scotia where the climate was not of the particular conditions described by Mr. Shoobridge as most favourable, the great depth of soil was perhaps the real cause. He noticed that in the valleys of Nova Scotia the English grasses and clover grew to such a height as to resemble a dense scrub. He did not think that the winter of Tasmania was severe enough to kill the insect pests.

His **Excellency** thought that Messrs. Shoobridge, Grant, Abbott, and Morton, if willing to act, might constitute themselves a body to obtain all information possible upon the subject with a view of reducing it to a practical form.

PAPERS.

"The Climate of Eastern Tasmania, indicated by its Lichen Flora:" by Rev. F. R. M. Wilson, Kew, Victoria, Corresponding Member Royal Society, Tasmania:—

During a visit of five weeks to Tasmania, in February and March, 1891, while exploring for lichens in the neighbourhoods of Launceston, Mount Arthur, Ulverstone, Hobart, Mount Wellington, the Huon River, and St. Mary's Pass, I was struck with the general and unexpected poverty of the lichen flora. And, on looking about for the cause of this, I noted the evident frequency of bush fires, which are the most destructive enemies of lichen growth. This, however, did not wholly explain the matter, for, even where the plants might be expected to recover from the action of the fire, their vitality seemed to be checked by the dryness of the climate. This was a discovery surprising to a Victorian, who had been accustomed to consider the climate of Tasmania a humid one. An examination of meteorological authorities, however, showed that in the eastern portion of the island the rainfall is not only less than it is in the western, but less than it is in Victoria. In the west and the highlands of Tasmania 75in. of rain have been registered in one year, and the average of the whole island is said to be 35in.; but the annual rainfall at Hobart is only 21·52in. These adverse influences of fire and drought doubtless re-act on one another; the fires thinning the forests and undergrowth and thus lessening the rainfall, and the lack of rain exposing the country to the ravages of fire. These influences, however, are considerably modified in the eastern part of Tasmania by the altitude of the mountains and by the ocean currents along the coast; both of which have a great effect upon the geographical distribution of lichens. When I visited Tasmania I was anxious to test a theory which I entertained with regard to the distribution of lichens in Australia. This theory was that the warm current from the tropical Pacific Ocean, passing down the east coast of Australia, carries southward the spores of tropical lichens and the conditions favourable to their growth, until it is met by the cold south-west seas and winds which greet the traveller when doubling Wilson's Promontory from the east. Nautical observations have determined the trend of this coastal current, and traced it from the tropics southward beyond Australia and along the eastern coast of Tasmania. Nylander tells us (Syn. Meth., p. 69) that the tropical zone is specially characterised by its epiphyllous lichens, notably by the genus *Strigula*, and, among cortical lichens, by the numerous species of *Thelotrema, Graphis, Chiodecton, Glyphis, Trypethelium,* and *Porina.* These genera, which are allied to the *Ascomycetes* among the fungi, are largely represented in Queensland, on the eastern or seaward side of the coastal ranges. All of these, except the *Porinæ*, appear along the coast of New South Wales, but are less numerous there both specifically and individually. In Victoria neither *Strigulæ* nor *Porinæ* have been found, unless in a very undeveloped state, and the other genera have far fewer representatives than in the more northern colonies. They are most frequent in the eastern part of Victoria. I discovered many species of *Graphis* and *Thelotrema,* and several *Chiodecta,* on the seaward slope of the dividing range to the east of Melbourne, and especially on the Gippsland coast, and one *Glyphis* and one *Trypethelium* at the lakes entrance in Gippsland. It remained to be seen whether or not my theory would be supported by lichenological explorations in eastern and north-eastern Tasmania. I had opportunity to test it on Mount Arthur and in St. Mary's Pass; and I found some of the same *Graphides* and *Chiodecta* and even a *Trypethelium,* which I had collected near Sydney and at the lake entrance in Victoria. Two or three species of *Chiodecta* I found, not only on Mount Arthur, but even as far south as Mount Wellington. The genus *Trypethelium* is especially tropical or sub-tropical, and the presence of one of this genus in St. Mary's Pass testifies to the geniality of the climate in eastern Tasmania. As in Victoria, so in the more southern colony, the warm current down the east coast of Australia brings southward conditions favourable to the growth of sub-tropical lichens. These facts, I think, suggest to the medical faculty what probably their experince has already proved, that the climate of east Gippsland and the eastern coast of Tasmania must be pre-eminently beneficial to invalids. Lichenological observations indicate that both of these places are favoured by a much milder winter, as well as a cooler summer, than the other parts of their respective colonies.

Mr. GRANT thought that the subject was a most interesting one from a botanist's point of view, and from the specimens laid upon the table it would seem that they were beautiful in form, and extremely interesting in every way. The collection of mosses were well worth looking at. They were done up in a most convenient form for examinations. There was no difficulty in getting at them, and the names were put upon them clearly and legibly. The Society was, he was sure, deeply indebted to the donors, from whom he hoped to have more shortly.

CORRESPONDENCE.

Cullenswood House, St. Mary's, May 2, 1892.—The Secretary of the Royal Society of Tasmania. Sir,—Having received a communication from Mr. E. D. Atkinson, of Wynyard, relative to the terrible destruction of the young of Puffinus brevicanda, or "mutton bird," at the Straits Islands, for the boiling down of their fat, I beg to bring the matter strongly before the Council of the Royal Society, with a request that a deputation of its members may wait upon the Government, and suggest the passing of an Act during the coming session of Parliament, which shall put a stop to the destruction of this species for the purpose complained of. I cannot do better than transcribe from Mr. Atkinson's letter what he says in reference to the slaughter of the birds :—"When I was there, and for some time previous, the young birds were being taken for the purpose of 'fatting,' that is, boiled down for their fat. On Green Island alone, five men were obtaining 2,500 birds a day, and this would be going on for several weeks. On Chapel and Babel Islands, which are much larger, the same thing was going on, but on a much larger scale. Some hundreds of thousands will be destroyed in this manner, and when I tell you the fat is 9d. per gallon, and it takes 120 birds to make one, you will see what rightful destruction is done for a miserable return. It is perfectly legitimate to take the birds for curing and keeping for food, but as there are too many for this they must destroy them in a wholesale way for fat; and this is done by one or two men only, the majority of the folks there and all the half-castes are against the fatting process. I was requested when there to see if anything could be done to have a stop put to it." This extract speaks for itself, and the points to be urged on the Government are:—The enormous destruction for a disproportionate, and as Mr. Atkinson says, a very miserable return, and the undoubted fact that the mutton birds will in a few years be driven way from these breeding haunts altogether, and the means of getting a living resorted to by the islanders entirely cut from under their feet.—I have the honour to be, sir, your obedient servant, W. V. LEGGE, Tasmania, Member of Committee for Preservation of Plants and Animals.

Mr. BERNARD SHAW said that perhaps Colonel Legge probably was not aware that there was a law to prevent the destruction of young mutton birds. This prohibited the taking of birds until they were fit for human food, and was instituted especially to prevent their wholesale destruction. This was the first season that the regulation had been in force, and he hoped that it would have a salutary effect. The constable who had charge of the islands was only recently appointed, and it would be his duty to see that the Act was carried out.

Mr. THOMAS STEPHENS hoped that the Act would be carried out efficiently. It was a subject which could scarcely be discussed without preparation. The birds formed the staple food of a half-caste population of the Straits, and they should be either compelled to restrain themselves in the wanton destruction of the mutton birds, or else be removed to another place. The natives could not be made farmers all at once, but their condition was being greatly improved. He regretted the absence of Bishop Montgomery, who had made himself acquainted with the condition of the half-castes in the Straits thoroughly. At certain seasons of the year the natives of the islands assembled to snare the birds. This had been going on for at least 50 years, and there did not appear to be any appreciable diminution in their numbers. He thought that if the law was a good one it might be very strictly enforced, as there were too many laws on the Statute Book of Tasmania already which were allowed to rest dormant.

Mr. SHAW said that there were four matters to be dealt with. The first was the destruction of the young birds, the next the taking of the eggs, the next the destruction of the birds by fire, and lastly, the injury done to the birds by the presence of cattle and sheep. He read the regulations in force upon the subject, which provided against the destruction of the birds as stated in the paper of Colonel Legge. These regulations were issued on the 12th December last.

PRESENTATIONS.

The Secretary called attention to a number of donations which had been sent to the Museum. Mr. W. A. Weymouth forwarded 85 specimens of mosses comprising 68 species. The Rev. F. R. M. Wilson sent in a number of specimens of lichens, which were like the mosses, mounted and classified. Mr. Omant presented samples of rocks from the West Coast, consisting of calcite and limestone, and which were said to be valuable for flux, analysis of which has already been published. A specimen of stone found near the Russell Falls was submitted by the Secretary to Mr. A. Montgomery, the Government Geologist, who said that on examination of it he found that it was not kaolin but pretty nearly pure silica, probably tripoli or infusorial earth. He stated that the infusorial earth had a considerable commercial value if of good quality, and he quoted the U.S. mineral statistics, it was shown that the production of 2,532 tons of 2,000lb., valued at 50,640dol., or about £4 a ton. This stone was found in connection with the lithographic stone recently referred to in a previous issue of *The Mercury.*

PAPER BY PROFESSOR TATE.

A paper was handed in by the Secretary, contributed by Professor Ralph Tate, F.L.S., of Adelaide, on the "Classificatory portion and synonyms of *Eaetoniella Rufilabris.*"

After the usual votes of thanks the meeting terminated.

JUNE.

The monthly meeting of the Royal Society of Tasmania was held in the Society's room at the Museum on Tuesday evening, June 14. His Excellency the Governor Sir R. G. C. Hamilton, K.C.B., LL.D., presided, and there was a good attendance of ladies and gentlemen.

A NEW MEMBER.

Mr. Charles Holdsworth was duly elected a Fellow of the Society.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE JOURNAL.

The SECRETARY (Mr. Alex. Morton) laid on the table Volume III. of the journal of the New Zealand meeting, which had just arrived. He also said the journal of the Hobart meeting was well in hand.

His EXCELLENCY expressed himself as highly pleased that the publication of the Hobart journal was being done so expeditiously.

CORRESPONDING MEMBERS.

The SECRETARY stated that the Council had under consideration Mr. Ogilvy's suggestions with regard to corresponding members throughout the country, and hoped to be able to report on it by next meeting.

PAPERS.

Notes on the Natural Limits to Occupation on the Land, by Mr. R. M. JOHNSTON, F.L.S.

Notes on the Square-set System of Timbering in Mining at Zeehan and Dundas, illustrated by a Model Square-set. By ALFRED J. TAYLOR, F.L.S.

His EXCELLENCY moved a vote of thanks to the gentlemen who had contributed. As regarded Mr. Taylor's paper, he was sure they had all listened to it with great interest. The explanation he had given was very clear, and he had no doubt his object would be fulfilled if the general attention of the mining public was directed both to the advantages and drawbacks of this description of timbering. (Applause.)

The proceedings then terminated.

JULY.

The usual monthly meeting of the Royal Society was held at the Museum on Tuesday evening, July 12. His Excellency the Governor

Sir Robert G. C. Hamilton, K.C.B., LL.D., presided, and there was a large attendance.

The Secretary stated he had received a telegram from Mr. Russell, the Government Astronomer of New South Wales, informing him that it would be impossible for his paper to arrive in Hobart by that night's train. The paper was one of very great importance, dealing as it did with the late Leake bequest in connection with astronomy. Under the circumstances he would ask for the paper to be postponed till next meeting.

SOME PLANTS NEW TO TASMANIA.

Mr. LEONARD RODWAY read some notes on this subject.

Mr. A. J. OGILVY read a paper entitled "Artificial obstructions to the occupation of the land."

The Rev. Dr. SCOTT, and Messrs. C. H. GRANT and A. J. TAYLOR spoke on the subject.

The Secretary (Mr. A. MORTON), on behalf of Colonel W. V. Legge, R.A., read a paper "On the Occurrence of some Australian *Ardeidæ* in Tasmania," discussion being postponed.

The meeting closed with a vote of thanks to all who had taken part in the proceedings.

AUGUST, 1892.

The monthly evening meeting of the Royal Society of Tasmania was held at the Museum on Monday, August 8. The President (His Excellency Sir Robert G. C. Hamilton) K.C.B., LL.D., presided, and there was a good attendance of Fellows.

CORRESPONDENCE.

The SECRETARY (Mr. Morton) read a letter from Mr. H. C. Russell, the Government Astronomer of New South Wales, with reference to his paper on the Leake bequest. The writer said he had ascertained that it would not be possible to get for Tasmania one of the telescopic instruments sent to South America. It would, therefore, be necessary to order one from the manufactory—either Sir Howard Grubb or M. Gautier, of Paris. Sir Howard Grubb's price was £1,800. He was unable to ascertain M. Gautier's figures. About 12 months would elapse from the date of the order until the instrument was ready for use. He had made no provision in the paper for architect's fee, as he had drawings and specifications for the Observatory which would serve the builder's purpose. For teaching purposes it would be convenient to have the Observatory close to the University, but as far from the railway as possible, as the vibrations caused by trains passing would to some extent interfere with photographic work. He hoped the Leake trustees and the Council would be able to carry out the proposal. The time fon the institution of an Observatory in the southern hemisphere was most opportune and might not come again for years.

THE LEAKE ASTRONOMICAL BEQUEST.

Mr. A. MORTON (Secretary), in the absence of the author, read a paper entitled the proposed "Leake School of Practical Astronomy," by Mr. H. C. Russell, F.R.S., the Government Astronomer of New South Wales :—

Mr. RUSSELL said during his visit to Hobart in January last he was struck with the brightness and translucency of the atmosphere, and it was evident to him that the weather of the fortnight he was in Hobart would have enabled him to do as much as he had done in Sydney during the preceding two months. And, in conversation with some friends, he expressed regret that such fine skies for the astronomer should not be taken advantage of, and an Astronomical Photographic Observatory established. He was told that Tasmania, like other parts of the world, was passing through a period of commercial depression, and the Government did not seem to be disposed to add to expenditure by starting an Observatory, but that the late Mr. Leake had left a sum of £10,000 for the foundation of a School of Astronomy, and it was hoped that an Observatory would be established very soon. And it seemed to him most fitting that the colony in which this noble bequest was made should be the first to take it up and benefit by its provisions; and the establishment of a Tasmanian University would, with the co-operation of the Council, enable the trustees to carry out in a most satisfactory manner the wishes of the testator, who indeed seemed to have contemplated such a natural combination as that now proposed between his trustees and the Council of the University for the establishment of a School of Astronomy. Such an addition as this to the functions of the University would be an immense advantage. In the first place, it would add to the curriculum another subject which students may take up, either as technical education or as a most valuable mental training in a general course of study. Next, it would induce some students to come to the University in order to attend the lectures on Astronomy, and if provision were made for non-matriculated students to attend the teaching in practical astronomy on payment of fees, there could be no doubt that many would enrol their names. The desire to contribute in some way towards the consummation of the proposed Observatory scheme, which seemed to him so desirable, and so easy of attainment with the means at command, had induced him to make the following suggestions; but before going on to these Mr. Russell said he would wish to point out that Hobart, in addition to its clear atmosphere, possessed in its high southern latitude a great advantage over any other available place for the new Observatory in the southern hemisphere. It was true that a slightly higher latitude was available in New Zealand, but the climate was less favourable, and the means to build an Observatory were apparently not forthcoming, and if one were erected in New Zealand it would no doubt be at Wellington. So that, practically, Hobart not only possessed the means, but also the best available site in the southern hemisphere for the Leake Observatory.

The paper dealt very fully with the subject, giving an estimate as to cost, etc.

The Rev. George Clarke, Vice-Chancellor of the University, said: I am sure that I only express the universal sentiment when I say that our very warmest thanks are due to Mr. Russell for the able and practical paper which has been read to this meeting. It is full not only of his interest in the general cause of science, but of his interest in the particular honour and welfare of Tasmania. One does not need to be an expert to accept his assurance that for position, climate, and atmospheric conditions the neighbourhood of Hobart is probably the best place in the Southern Hemisphere for astronomical observation. There are problems waiting to be solved for which we can furnish the *data* more easily than they can be obtained elsewhere; and of Mr. Russell's kindly feeling towards us, and his desire that we should have the benefit of our position, his paper is sufficient indication. As far as I can gather, it is the feeling of all the colonies that we should have the first and fullest chance of appropriating Mr. Leake's munificent bequest, and that it should only be on our failure in power to take it up that its benefits should be thrown open to the competition of the outside world. It would be satisfactory to know how far our opportunity of acceptance may be extended. We have not, of course, the slightest right to dictate to the executors of Mr. Leake's will, but we might suggest that the matter should not be finally disposed of until ample time is granted to us to avail ourselves of the bequest. As far as regards the proposed association of this fund with the University, I can only speak for myself, and may not commit the Council to any opinion that I may now express. We must all be struck with the very direct and practical character of Mr. Russell's suggestions. He contemplates chiefly the establishment of an Observatory, and the means of carrying on its work. No doubt in a new community like ours the immediate practical work is a great consideration. But as far as I can judge, the University Professorships in Astronomy in the Old Country look to the teaching of higher mathematics very much more than to the manipulation of instruments for the necessary qualification of professorship. I think we should have to invert the order of requirement and to look more to practice than theory, which would involve our taking a course for ourselves for which we need time and consideration. I received to-day a note from Mr. Waterhouse of Launceston, which indicates some of the questions we should have to thrash out. It is not an official note, and I will trust to my friend's forgiveness if, with your permission, I read it.

"LAUNCESTON, August 4th, 1892.

"MY DEAR MR. CLARKE,—I am afraid that Mr. Walker has considerably over-estimated my powers of making any helpful suggestions as to Mr. Russell's paper on the Leake trust, and the relation of the University to it. I have ransacked my ideas very fully, but cannot get anything very satisfactory out of them. I must take Mr. Russell's figures as correct, viz., £3,000 for apparatus, etc., and £7,000 for investment, producing £350. If the Lecturer in Mathematics and Physics is to give instruction in popular Astronomy, and is to supervise and control the University, it would not be fair to ask him to do this extra work,—work which is quit eoutside the duties set forth by the University in inviting applications,—without receiving extra remuneration, and this extra remuneration should come out of the Leake trust. The £100 a year proposed by Mr. Russell seems to be a fair estimate. The late Professor Adams (Professor of Astronomy and Geometry) at Cambridge, was entrusted with the superintendence and management of the Cambridge Observatory at an extra stipend. I knew very intimately the Observer at the Observatory, and I know this, that he did the usual every day work connected with the Observatory, reporting to the Professor from time to time. If the proposed lecturer has graduated as a wrangler at Cambridge, or has taken a degree in honours at any University where the course requires a knowledge of astronomy at all equal to what is required in the Cambridge course, there can be, I think, no doubt of his ability to do all the duties required of him under the Leake trust, especially if he rubbed up his knowledge of the instruments by attending for a few months at the Melbourne or Sydney Observatory prior to taking up his duties here. But what we shall require in order, in my opinion, to qualify the University to take the benefits under the Leake trust, is an Observer or assistant. There will be, after providing for the £100 a year additional salary to the lecturer, and the £50 required for annual incidental expenditure (according to Mr. Russell), only £200 for the observer's salary. That might enable us to get a capable man, without addition, although I rather doubt it. An extra £50 or £100 from the University funds might do so. Such an observer would, of course, be able to demonstrate at the lecturer's astronomical lectures, and might be able to demonstrate in Physics and do the photography. But I do not think that £250 or £300 a year would get us a man with both these capabilities. Still, with a lecturer and an observer to demonstrate at the astronomical lectures, we should, I think, qualify for the Leake trust, though, of course, not so fully as under Mr. Russell's scheme. If to the £200 left from the Leake trust the Government would add the £150 or £200 per annum recently voted to the meteorologist on condition of the observer's taking up those duties, which, of course, would fall in most easily with his ordinary duties, we ought to be able to get a very good man, and able to demonstrate in physics, and with some skill in photography. I wish to say again, and more emphatically than I have before, that I do not think we need import an astronomical expert in order to give the instruction in astronomy and to superintend the Observatory. When the late Professor Adams made his calculations which led to the discovery of the planet Neptune, he was engaged at tutorial work in mathematics generally, and had only taken his degree two years before; he made his calculations, apart from observations, and then communicated the result of them to Professor Challis and the Astronomer Royal, who, by observations, verified his calculations. And again, his *locum tenens* during his illness; and I believe now his successor, Mr. Hobson, of Christ's College, took that position, not by virtue of any special practical experience at the Observatory, but by virtue of his general excellence in mathematics, and I know that when he took his degree his astronomy was not his peculiar forte. I am afraid that we cannot, as I hoped we should have been able, provide for a lecturer in mathematics and a lecturer in physics out of the Leake trust and probable Government aid, *i.e.*, meteorologist's salary, for we shall have to provide for an observer and for incidental expenses.—Believe me to be, yours very sincerely, G. W. WATERHOUSE."

I think that in the circumstances such a resolution as I will now propose will best meet the case:—

"That the Secretary be requested to communicate with the Council of the University, and to ask if they are willing to appoint a committee to confer with a similar committee of the Royal Society on the Leake bequest to promote the study of astronomy, the joint committees to suggest and report to the Society and the Council such a scheme as may be practicable in order to secure the benefit of Mr. Leake's bequest to the colony of Tasmania."

His Honor, SIR LAMBERT DOBSON, Chancellor of the University, on seconding the resolution, eulogised the munificent nature of the bequest. To carry out their wishes it was necessary they should have the co-operation of three bodies, namely, the Leake trustees, the Government, and the Council of the University. If it was in no sense contrary to Mr. Leake's directions, he did not think that there would be great objection to the Observatory being established in this part of the Southern Hemisphere. So far as the Government was concerned, there was a sum on the estimates for the meteorological establishment, which he thought the Government would be glad to hand over towards the carrying out of such a scheme if the Observatory did the work. He was glad to notice the attention being given to that important branch of the subject—astronomical photography—and its great value in the science had already been abundantly demonstrated by experiment. It was for them now to work out all the details, and approach the trustees with a scheme which fully complied with all the conditions of Mr. Leake's bequest.

Mr. T. STEPHENS, Director of Education, anticipated that two or three years might elapse before funds were at the disposal of the trustees to give effect to the bequest. This was a serious obstacle to any immediate attempt to combine the functions of University Lecturer in Mathematics with the duties to be performed under the Leake bequest. The University must act at once in the matter of its own appointment. He moved—"That it is highly desirable that a school of practical astronomy should be established at Hobart in accordance with the suggestions of Mr. H. C. Russell, subject to such modifications as circumstances may require."

Mr. J. B. WALKER said that the paper which had been read was most valuable, not only as the testimony of a high authority to the pre-eminent advantages of Hobart as a site for astronomical work, and especially for stellar photography, but also for the clear and practical directions it contained as to the requirements of an Observatory and the cost of apparatus and maintenance. He thought that Mr. Russell's proposal would offer a strong inducement to the Leake trustees to bestow this noble gift within their own colony. Co-operation with the great Observatories of the world in the special work proposed would at once give the Leake Observatory a certain prestige, and the name of its founder would be associated with a scientific undertaking of universal interest and importance. This would be attained without detriment to the express object of the donor, which was the practical teaching of astronomy in connection with a University. It was premature to discuss details; but he might suggest that as it was impossible to divorce astronomy from the study of the higher mathematics, the Leake professor would naturally take the higher mathematical work of the University. With the co-operation of the different bodies mentioned by Mr. Clarke, arrangements might be made for two University lecturers. The lecturer in physics could take a part of the mathematical course, leaving the Leake professor free to give his whole attention to the astronomical work and the higher branches of mathematical study.

Extract from the will of Mr. Arthur Leake, late of Ashby, Ross, Tasmania :—

"I direct my said trustees to stand possessed of a third sum of £10,000, upon trust for the purpose of founding or establishing a school for the practical teaching of astronomy, in any of the Universities, colleges, or leading schools mentioned in Clause 6 of this, my will; [*i.e.*, in either of the Australian cities of Hobart, Sydney, Melbourne, Adelaide, or Brisbane;] a part of such teaching to consist of demonstrative lectures with diagrams and instruments. And I declare that it shall be lawful for the persons for the time being holding the said sum of £10,000 to lay out and employ £3,000, part thereof, in purchasing and providing instruments in aid of such teaching."

Another clause of the will authorises the trustees to pay over the said sum of £10,000 to the University in connection with which the school may be founded.

The REV. DR. SCOTT thought there would be insuperable obstacles the way of attaching the Leake bequest to the chair of mathematics. in The Leake bequest at the very outset contemplated the establishment of a school for the teaching of astronomy, and the whole terms of the will implied that the teacher should be a teacher of astronomy, having also attached his chair to the work of demonstration in such a way as to give up his time very largely to this important branch of learning.

Mr. H. C. KINGSMILL, M.A., dealt with the teaching aspect of the question, and thought that whilst the scheme contained many excellent points the duties in connection with the Observatory could not very well be undertaken by the professor of mathematics.

A further resolution was passed, on the motion of Sir LAMBERT DOBSON, seconded by the Hon. N. J. BROWN,—"The Royal Society having placed itself in communication with the Council of the University with the view of formulating a scheme for securing the benefit of the Leake bequest to the colony of Tasmania, the Premier be requested to refrain from making any permanent appointment to the office of meteorologist pending the result of such conference."

REMARKS ON SIR ROBERT BALL'S PAPER (READ AT THE HOBART MEETING OF THE AUSTRALASIAN SCIENCE ASSOCIATION),. ENTITLED: "THE ASTRONOMICAL EXPLANATION OF A GLACIAL PERIOD."

By A. B. BIGGS.

The author said he wished to refe-
at the Hobart meeting of the

entitled "The Astronomical Explanation of a Glacial Period." He said that the purport of Sir Robert Ball's paper, which disputed some of the deductions of Sir Robert Herschel in his "Outlines of Astronomy," shows that the successive periods of glaciation, alternating with periods of genial or tropical temperature, which geologists infer from the indications of the rocks and strata, are necessary corollary from astronomical data. Having fairly stated the conditions of the problem, Mr. Biggs proceeded to say that the statement on which Sir Robert Ball founded his charge against Herschel could only be that on page 333 of the fifth edition of Herschel's "Outlines of Astronomy"—"Supposing the eccentricity of the earth's orbit were very much greater than it actually is, the position of its perihelion remaining the same, it is evident that the character of the seasons in the two hemispheres would be strongly contrasted. In the northern we should have a short but very mild winter, with a long but very cool summer,—that is, an approach to perpetual spring; while the southern hemisphere would be inconvenienced and might be rendered uninhabitable by the fierce extremes caused by concentrating half *the* annual supply of heat into a summer of very short duration, and spreading the other half over a long and dreary winter, sharpened into an intolerable intensity of frost when at its climax by the much greater remoteness of the sun." Reading this, however, with another extract from the same author, he thought Herschell's meaning would be sufficiently apparent, although he had in this case failed to express himself with his customary preciseness. His statement, said Mr. Biggs, is that "the hemisphere would be inconvenienced . . by concentrating half *the*" (not *its*) "annual supply of heat into a summer of short duration," etc., which is, of course, apportioned between the summer of one hemisphere and winter of the other alternately, and he can only be referring to that portion of this "supply" which pertains to the summer or winter of either hemisphere. That he could have meant nothing else is still more evident from a further quotation (page 230), in which he admits the unequal distribution of heat between summer and winter:—"Whenever, then, the sun remains more than 12 hours above the horizon of any place, and less beneath, the general temperature of that place will be above the average; when the reverse, below;" that is, the summer and winter portions of the year respectively. The extent of the inequality of the distribution of the annual supply of heat between the summer and winter portions of the year in either hemisphere depends wholly and solely upon the inclination of the earth's axis, and no one could be more cognisant of this fact than Sir John Herschel.

Mr. STEPHENS exhibited a specimen of an *Orthoceratite*, belonging to the genus *Actinoceras*, from the Silurian limestone at Railton, in the Mersey district, and stated that he had sent a portion of the fossil, which, when found by Mr. Hainsworth, was in three pieces, to Sydney for identification; but Mr. Etheridge said that it was not perfect enough to determine the species. The rock in which it was found was the same as that in which extensive borings had been undertaken on the pretence of searching for coal, and that too where the Silurian rock cropped out on the surface, and no coal measures existed.

TASMANIAN MOSSES.

The SECRETARY drew attention to a fine collection of Tasmanian mosses, beautifully mounted, and presented to the Museum by Mr. W. A. Weymouth, consisting of 57 specimens representing 50 species, making a total of those previously presented in May last by Mr. Weymouth, of 117 species.

The meeting terminated with the usual votes of thanks.

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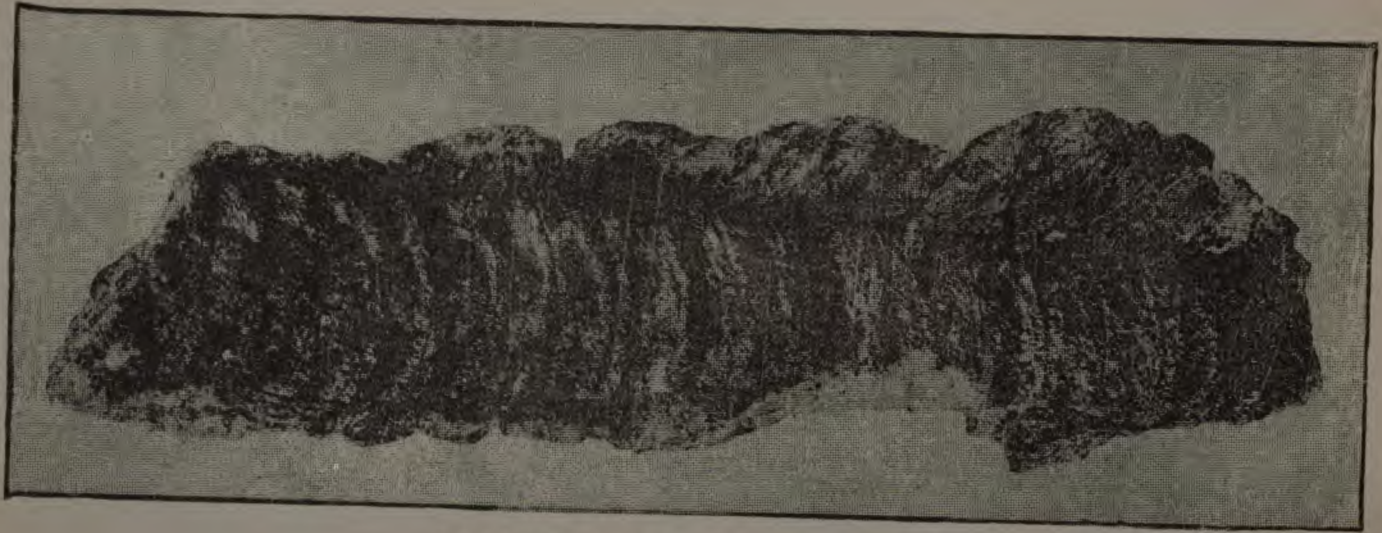

ACTINOCERAS Sp.

NAT. SIZE

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The meeting terminated with the usual votes of thanks.

SEPTEMBER, 1892.

The monthly evening meeting of the Royal Society of Tasmania was held on Tuesday, September 13th. The President, His Excellency Sir R. G. C. Hamilton, K.C.B., LL.D., presided.

PAPERS.

Mr. R. M. JOHNSTON, F.L.S., in commencing the reading of a paper entitled, "What are the conditions which determine the just and equitable representation of the people?" said that instead of his paper being based on theory, having had much to do with the question of the representation of the people, he felt that he could give some information and advice. Also, he thought, the difficulties which presented themselves to his mind from time to time might be of service to those who had to deal with the question. To secure a just and equitable representation of the people in Parliament was a matter which had at all times engaged the attention of thoughtful, practical legislators, and great thinkers. The paper was listened to very attentively, and at the conclusion the Hons. J. W. Agnew, N. J. Brown, A. J. Ogilvy, and A. J. Taylor replied.

The Secretary (Mr. A. MORTON), read some notes on the habits of some Tasmanian insects.

His EXCELLENCY in proposing a vote of thanks to Mr. Johnston and Mr. Morton for their papers, said as regarded the former the subject was one of extreme importance and very great interest. It was very desirable that occasions should arise like the present when a question of that sort could be discussed in the calm atmosphere of a room like that, instead of creating as it might keen political feeling. (Hear, hear.) He had never before seen the question analysed, and as Mr. Johnston had treated it.

The meeting then closed.

NOVEMBER, 1892.

More than ordinary interest centred in the closing meeting for the present session of the Royal Society held on Monday. It was the last occasion on which Sir Robert Hamilton would preside at the Society's meetings, and also the time selected for the delivery of his valedictory address as President. The Art Gallery at the Museum was prepared, and provided splendid accommodation for the 200 or more ladies and gentlemen, members, and their friends, present on the invitation of the Council. His Excellency and Lady Hamilton were received by the Council and Secretary. The audience included the Premier (Hon. Henry Dobson) and other members of the Ministry. Apologies for absence were received from two members of the Council.

Mr. MONTAGUE RHYS-JONES, C.E., read an elaborate paper on the "Elgin Marbles, The Acropolis, Phideas and his Works, Historical and Architectural Description of the Parthenon, including the Pediment, Metopes, and Friezes." The paper was strictly classical, but the writer's lucidity, coupled with a number of lantern slides of the principal subjects skilfully thrown on the screen by Mr. N. Oldham, rendered the whole easily intelligible, and it was consequently much appreciated.

The following papers were taken as read:—"Note on the Voracity of the Kelp Fish," and "Note on the Tasmanian Acanthiza," by Col. W. V. Legge, R.A., F.Z.S. "Concerning various means of encouraging the Study of Natural History in Tasmania," by Mr. J. R. McClymont, M.A. "Notes on Tasmanian Crustacea, with description of New Species," by Mr. Geo. M. Thomson, F.L.S., New Zealand. "Notes on Some Plants New to Tasmania," by Mr. Leonard Rodway.

On the proposition of the PRESIDENT a unanimous vote of thanks was accorded the writers of the papers.

THE PRESENTATIONS.

The Hon. J. W. AGNEW (honorary secretary and senior vice-president of the Society), in prefacing the reading of the following address to the President, referred eulogistically to the warm practical interest Sir Robert Hamilton had displayed in the operations of the Society. In comparing his Excellency's active work for the Society with the indifference of other influential members of the community, he asked for larger support, science, like war, requiring sinews; he also reminded the audience that the Society was the only link between science in Tasmania and the rest of the world, and stated that the Society held considerable and more communication than was generally supposed with similar organisations in Europe, England, America, Canada, South Africa, Asia, and the other Australian colonies.

To His Excellency Sir R. G. C. Hamilton, K.C.B., LL.D., President of the Royal Society of Tasmania.

Sir,—On the eve of your departure from the colony we, the Council of the Royal Society of Tasmania, desire to express, on behalf of the Fellows, our warm and cordial appreciation of the deep and practical interest which your Excellency has ever taken in the work of this Society. That this interest has been real and unwavering is shown by the fact that during the entire term of your official connection with the colony, now nearly six years, you have never failed to preside at our monthly meetings, except on two occasions only, when circumstances rendered it impossible; and not only is the Society indebted to you for contributions to its proceedings, but it has been enriched by your very liberal and valuable donations of standard works to the library. It is, therefore, almost needless to say we deeply regret that these pleasant relations, which have so long existed, are about to be severed, though we may be allowed at the same time to express a hope that the Society may still have the great benefit of your co-operation as a corresponding member. It only remains for us to offer our best and heartiest wishes for your future, whether passed in an official or private life; and as Lady Hamilton has been a not unfrequent visitor at our meetings, we respectfully beg to join her name with yours when we now bid you farewell. We remain your Excellency's very obedient servants—

(Signed by the Council and secretary).

Mr. BARNARD, vice-president and senior member of the Society, said: Your Excellency and Lady Hamilton, by way of supplement to the address which has just been presented to Your Excellency by Dr. Agnew, I have now the pleasant and agreeable duty to perform on behalf of the Council and Fellows of the Royal Society, of offering for Lady Hamilton's acceptance a Tasmanian black opossum skin rug as a token of the personal respect and esteem in which she is held by the members of this Society. It is not too much to say of Lady Hamilton that she is a pattern of all the domestic virtues, and that during her residence in Tasmania she has, both by precept and example, exercised a beneficial influence upon society generally, and upon young people in particular, that is likely to prove of lasting effect. Utility and comfort, rather than ornament and show, have been studied in the selection of the souvenir now presented, and it is hoped that Lady Hamilton in her travels in other and far distant lands, and under less genial skies, when using the carriage rug, will often be reminded of her pleasant sojourn in our sunny island of Tasmania. It now remains only to convey to Lady Hamilton our best wishes for the health, happiness, and prosperity of herself and family, and to express our sincere regret that we have so soon to say farewell. (Applause.)

The PRESIDENT said: Vice-presidents and members of the Royal Society,—I can only express my heartfelt thanks to you for the address which has just been read. If anything can add to the pleasure with which I receive it it is that it has been read by my dear friend, Dr. Agnew—(applause)—whom we are all glad to see amongst us again. (Renewed applause.) You have kindly referred to Lady Hamilton in your address. I can only refer to your kind action in giving her this beautiful token of your regard, and leave her to acknowledge its receipt herself (Applause.) I will just say one word before sitting down. You have been good enough to say that you hope I will become a corresponding member of the Society. I shall certainly have much pleasure in doing so—(applause)—and if the wheel of fortune in its revolutions should ever bring me back here as a resident of Tasmania, I hope you will allow me to resume my work amongst you as a working member. (Loud applause.)

Lady Hamilton, who received an ovation on rising, said:—Vice-presidents and members of the Royal Society,—I am extremely obliged to you for the beautiful present you have given me this evening. To think that it should have been presented by the hand of Mr. Barnard, who 51 years ago was made a member of this society by Sir John Franklin, is, I feel, a great honour. I shall never forget, however far away, how very good the members of the Royal Society have been, not only to me, but to every other woman in Tasmania, in allowing us to come here and improve our minds amongst the valuable properties of such a society as this. (Loud applause.)

THE SOUVENIRS.

The address was full bound in scarlet Turkey Morocco, bevelled boards, extra elegant, tooled in the Italian style of ornamentation, with a gold line border on the outside, and a broad margin in gold tooling on the inside of the covers. On the side, lettered in gold, were the words:—"Presented to His Excellency Sir Robert G. C. Hamilton, K.C.B., LL.D., President of the Royal Society of Tasmania." The engrossing was an exceedingly neat piece of penmanship (the work of Mr. Albert Reid), the delineation of the church text characters being clear and with just sufficient ornamentation to produce a pleasing artistic effect. The address was encircled by two wreaths of Tasmanian flowers and berries, painted in water colours by Miss A. Hall and Miss V. Hall. Altogether it forms a work of art, and reflects great credit on the artists; particularly so is this the case with the binding, which was executed by Mr. T. Young (Messrs. J. Walch and Sons). The rug was skilfully made of picked black opossum skins of extra size, lined with blue cloth, and made by Mrs. Paget, furrier, Murray-street.

The whole of the arrangements in connection with the meeting were ably carried out under the direction of the secretary (Mr. A. Morton).

THE PRESIDENT'S ADDRESS.

His Excellency Sir Robert G. C. Hamilton, K.C.B., LL.D., delivered the following address:—

Fellows of the Royal Society of Tasmania,—

During the Session, which closes this evening, eight meetings have been held, and twenty-two papers have been read. The number of Fellows of the Society has been increased by 12, and the number of Corresponding Members by eight. The Society has sustained a loss by the death of Captain Shortt, R.N., who for 10 years held the post of

Meteorological Observer for Tasmania. Captain Shortt furnished this Society with many valuable notes. He was a regular attendant at our meetings and took part in our discussions, although the hour at which he made his evening observations necessitated his leaving generally before they were over. He was an accurate and careful observer, and his sound common sense in dealing with his observations rendered them of much practical use.

The papers submitted to the Society this session have been of considerable interest and value. Mr. J. Shirley, one of our corresponding members, furnished a list of the known Lichens of Tasmania, and the Rev. F. R. M. Wilson, F.L.S., of Victoria, another of our corresponding members, submitted a paper on "The Climate of Eastern Tasmania, indicated by its Lichen Flora." Mr. A. T. Urquhart furnished notes "On some Tasmanian Spiders," and Mr. A. Morton "On some Tasmanian Insects, Thyrmeleon Sp. and a Cicadia." Mr. T. Stephens, M.A., read "Some Notes on a Specimen of Orthoceratite from the Silurian Limestone at Railton, in the Mersey District." Professor Ralf Tate, F.G.S., who will be the next President of the Australasian Association for the Advancement of Science, furnished a paper on the classificatory portion and synonyms of the *Eaetoniella Rufilabris.* Colonel Legge submitted some notes "On the Occurrence of some Australian Cranes, *Ardiedæ,* in Tasmania;" "On the Destruction of Mutton Birds in the Straits Islands;" "Note on Voracity of the Kelp Fish;" and "On a Tasmanian Acanthiza (Bush Tit)." Mr. G. M. Thomson, F.L.S., of New Zealand, a corresponding member, furnished some "Notes on Tasmanian Crustacea, with description of a New Species;" and Mr. J. R. McClymont, M.A., some remarks concerning various means of encouraging the study of Natural History in Tasmania." Mr. A. J. Taylor, F.L.S., laid before us some "Notes on the Square-set System of Timbering in Mining at Zeehan and Dundas," and "On the use of the Woomera, or Throwsticks, by the Aborigines of Tasmania." Mr. A. B. Biggs submitted some "Remarks on Sir Robert Ball's paper read at the Hobart meeting of the Australasian Science Association, entitled "The Astronomical Explanation of a Glacial Period." From Mr. H. C. Russell, F.R.S., Government Astronomer of New South Wales, we had a most interesting and valuable paper "On the Proposed Leake School of Practical Astronomy," in which he recommended that the Leake bequest of £10,000 should be handed over to the Tasmanian University, who should establish a school of astronomy, and an observatory, to be called the Leake Observatory. This proposal is now before the Council of the University, and it is to be hoped that the trustees of the bequest and the university authorities will see their way to carry out Mr. Russell's suggestion. I think we all agree with him when he says, "It seems to me most fitting that the colony in which this noble bequest was made should be the first to take up and to benefit by its provisions." At our first meeting this session we had a paper from Mr. W. E. Shoobridge on "Tasmanian Apples in London." In this interesting paper, which gave rise to a good deal of discussion, Mr. Shoobridge deals with the effect of soil, irrigation, and climatic conditions in the production of apples, and with the best means of securing that they reach the English market in a perfect condition. An industry of this sort is always subject at starting to severe checks from a want of knowledge as to the conditions most suitable to its proper development, and careful and accurate observation in every detail are essential before such knowledge can be attained. But these difficulties will be overcome, and, in my view, there is a great future for this industry, which will in time become as stable an industry as is that of Australian frozen meat, and I believe it will be a source of much wealth to Tasmania in future. To-night we have had the pleasure of listening to an interesting paper, by Mr.

M. Rhys-Jones, on the Elgin Marbles in the British Museum, illustrated by views shown to us by means of limelight.

I have now referred to all the papers which have been laid before us this session, with the exception of those bearing on social and economic matters. These are, "Notes on the Natural Limits to Occupation of the Land," by Mr. R. M. Johnston, F.L.S.; "Artificial Obstructions to the Occupation of the Land," by Mr. A. J. Ogilvy; "What are the Conditions which determine the Just and Equitable Representation of the People?" by Mr. R. M. Johnston; and "Trades Unionism as a Factor in Social Evolution," by Mr. A. J. Taylor. The attention which is now being given on all sides to social and economic subjects has thus left its mark upon the work of our Society for 1892, and the papers enumerated above, and the discussions arising upon them, form a marked feature in this year's proceedings. While on the one hand I myself should be very sorry to see the Royal Society of Tasmania so far depart from the original intention of its founders as to develop into more or less of a debating society on social and economic subjects, on the other, to exclude a discussion of such subjects from a scientific standpoint would, in my view, be the greatest mistake this Society could make. As I ventured to say in my inaugural address to the Australasian Association for the Advancement of Science, which met in this city in January of this year: "There never was a time in the history of the world when there was a greater necessity than there is now for a wider and clearer conception of economic truths, for problems of the greatest import are pressing for solution. While, on the one hand, no adjustment of these problems based upon selfishness and individual aggrandisement, or which does not recognise *duties* as well as *rights*, can or ought to stand; on the other, there is no small danger that an unwise acceptance of some of the more advanced of what are commonly called socialistic views might lead to the motives of human energy and of human exertion being so lessened as materially to interfere with the progress and advancement of the human race. I am not one of those who apprehend catastrophe arising in the inevitable development of a new industrial and social system, but if catastrophe does arise, it will arise from want of knowledge, and not, as some fear, from the prevalence of any spirit of anarchy. A wider and sounder knowledge of economic truths will, however, in my humble judgment, in process of time, lead not only to a satisfactory solution of present social difficulties, but will tend to develop conditions under which culture will be brought more within the reach of all." Holding these views, as I do, most strongly, I should deeply regret if this Society, which is the centre of scientific life in Tasmania, should ever discourage the discussion of such subjects at its meetings, provided, of course, that these discussions are conducted in a scientific spirit.

But while I consider that the fullest use of the meetings of this Society should be made for the discussion of this branch of science, I am very anxious that the original intention of its founders should be carried out even more fully than it is at present. That was, as you know, to encourage investigation into the plant and animal life of Tasmania, and to obtain, as far as possible, faithful and trustworthy records of the interesting forms and laws under which mineral, plant, and vegetable existences exhibit themselves in Tasmania. With this view I strongly commend to the Society the plan proposed some time ago to the members, by Mr. A. J. Ogilvy, for mapping out the country into districts, and appointing an honorary representative of the Society in each. I believe something has already been done in this direction, but I strongly advise the Society to carry it out systematically. If a representative of the Society were appointed in each district, the residents in such district would know whom to approach with anything of interest, and from this representative the Royal Society would receive reports. Much useful information would thus be gained which might otherwise be lost.

At one of our meetings Mr. Leonard Rodway called attention to the necessity which exists for a complete handbook of the botany of Tasmania, and he is now actively engaged in compiling such a work. It is much needed, for the only two comprehensive works which exist on the subject, viz , Hooker's great work, "Flora Tasmaniæ," and "Flora Australiensis," by Baron Von Müeller and G. Bentham, which includes the whole Flora of Australia, are far beyond the means of many of our botanical students and collectors. I need not say that Mr. Rodway's praiseworthy and useful work has the hearty sympathy and support of our Society.

As I have now held the office of President of this Society since 1887, and as this is the last occasion on which I shall have the privilege of addressing you, I will briefly place before you what our tale of work has been for this period. We have had 127 papers read before the Society ; of these there were 14 in Astronomy, five in Chemistry and Mineralogy, 20 in Geology and Palæontology, 58 in Biology and Botany, 13 in Geography, and 16 in Economic and Social Science and Statistics, and the paper we have heard this evening on the Elgin Marbles. Looking back over these six sessions, I think a good deal of work has been done in them, and that there has been no falling off in the health and vigour of the Society. I should have liked, had time permitted, to have referred specially to some of this work, but as I have passed it in review already in my annual addresses to you at the close of each session, it perhaps is scarcely necessary that I should go over the same ground again. I desire, however, this evening to invite your attention to some directions, outside of our own operations, but interesting to us as a Society, in which progress has been made while I have been your President. During that time the building in which we now are has been extended by the addition of a new wing. The foundation stone of this addition was laid by that good friend of the Museum and of the Royal Society, Dr. Agnew, on December 23, 1886, and I had the privilege of declaring it open on May 22, 1889. This increase in space has been of the greatest use, not only in enabling a better disposal of objects of interest to be made for exhibition, but also for the accommodation of the rapidly growing additions to the Museum collection which, without an increase of space, could not have been exhibited at all. But the great feature of the new wing was that it provided an Art Gallery. Many valuable works of art have been placed in this gallery on loan, and a considerable number of valuable presentations have recently been made to it. Among them, I would refer to a water-colour scene in Italy, presented by Sir Lambert Dobson ; an oil painting, by E. J. Poynter, R.A.; and a water-colour by E. M. Wimperis, presented by Miss Ada Wilson ; and a series of landscapes, depicting the scenery of the Western Highlands of Tasmania, by our celebrated local artist, Mr. W. C. Piguenit, presented by the Government. A large number of students avail themselves of the privilege of copying the works of art exhibited in the gallery, and there can be no question that a taste and love for art is being generated in our midst, which, as time goes on, must infuse some strain of its elevating and refining influence into the national character of the future. Merely to stroll through the gallery and look at its works of art has an elevating and refining tendency, and I am glad to know that the attendance, both at the Art Gallery and the Museum is steadily increasing. The Curator informs me that it now amounts to about 1,000 a week. It is not only in Hobart that progress has been made in this direction. At Launceston, also, a new Museum and Art Gallery have been established, which I had the privilege of declaring open on 29th April, 1891. This undertaking is as yet only in its infancy, but it is progressing most satisfactorily. It already has a large daily attendance, and it fulfils for the North of the Island the same functions that the Hobart Museum and Art Gallery are fulfilling for the South.

In technical education, a matter in which we, as a Society, are greatly interested, immense strides have been made during the time I have been your President. There are technical schools now in operation in Hobart, in Launceston, and even in some of the smaller towns in the island, and I understand that the fine Technical School building in Hobart, of which I laid the foundation-stone so recently as July 10, 1889, has now so large an attendance that its accommodation is seriously taxed. A separate department has been formed to deal with agricultural education, and we have now an Agricultural Council disseminating knowledge respecting agriculture in all its branches, a function which the experience of this Society shows to be so necessary for the progress and well-being of this dominant industry. The possibilities of expansion in this industry are great, but an essential condition of such expansion, in profitable directions, is a wider knowledge of the laws which Nature has established, and of their operation and application to our needs. Such knowledge it is the main function of the Agricultural Council to disseminate in our midst, and its work in this direction has the heartiest sympathy of our Society.

During the same period, too, the University of Tasmania has been founded, and although it is early yet to speak of what it has done, it has great days before it. The gentlemen charged with its administration seem to me to be going the right way to work. They are fully alive to the fact that you must walk before you can run, and that you do not require a miniature Oxford or Cambridge in Tasmania. They know that science teaching must occupy a more prominent place in their curriculum than it does in the curriculum of these ancient seats of learning, and they will not be deterred from utilising their University to meet the wants of the community by any consideration that in so doing they may be departing somewhat from the functions of the old Universities at Home. But I am glad to see indications of a determination on their part that their standard shall be high. In this they are right and wise. The time must come when Hobart will be a great educational centre of a united Australia, and the higher the standard in Tasmania is known to be, the sooner will its University attract the youth from the other colonies, who will get at its seat of learning an education and training at least equal to that their own Universities afford, while at the same time they will be laying in a store of health and vigour, which, in the battle of life, is second only in importance to education itself.

In addition to all these new agencies working steadily and continuously in the direction of educational progress, two events have occurred during my term of office whose influence has been strongly in the same direction. I refer to the Exhibition at Launceston, so successfully managed, which must have had a great effect in opening and enlarging the minds of the many thousands of our people who visited it, and to the meeting of the Australasian Association for the Advancement of Science, held in this city in January last. I can see throughout the country evidence of the healthy stimulus caused by that gathering, and it is to me personally, having had the honour of being its president, a matter of the utmost satisfaction that the meeting was an undoubted success. Out of this meeting sprang the Australasian Home Reading Union, which I believe will, in conjunction with our numerous literary and debating societies, exercise a continuous, and, I hope, an ever-increasing influence in developing a taste for instructive reading among our people, and in directing home study to definite ends.

The advancement all round during the time I have been here has been very marked. Living near the Domain, as I do, I am struck by the improvements constantly being made in it, still more beautifying that beautiful park. The means of access to objects of interest in the neighbourhood of the city have been greatly improved. Only two years ago a stranger might easily have lost his way in going up Mount Wellington, a journey which every stranger should make. Now there is an excellent track right to the summit, from which, as we all know, a glorious view is to be had. When I came to Tasmania I had to land from my steamer in a tender. Now the largest steamships afloat lie alongside of our wharves. At that time if I wanted to telegraph to England I had to pay 9s. 11d. a word. Now it is less than half that amount. Then a letter Home cost 6d. for postage; now the cost is 2½d.

But when I have been indulging in this vein in conversation lately, I have not unfrequently been met by the rejoinder, "True, there has been great advancement, but all that has come to an end, and the country is in a more depressed state than it has ever been before." I should be the last to make light of the present financial difficulties of the country. That a small community like ours should have to pay upwards of £300,000 a year, or about £2 a head for every man, woman, and child in the island, outside of our borders, for interest of money borrowed, at a time when our industries, out of the profits of which alone this payment can be made, are in a depressed condition, is a serious matter. But I see lights through the darkness. Your natural resources are great, and your productions must and can be increased. You have recently passed through a period of most unhealthy speculation in mines, and are suffering from its inevitable collapse. The "haste-to-be-rich" which such a time necessarily induces is, however, now being replaced by that honest industry which alone can make a country really prosperous. In a time of speculative excitement it is true that certain individuals may be enriched by the transfer of wealth from other individuals, who of course are so much the poorer, but the actual total production of wealth in the country is not increased by such transfer. On the contrary, there is a diminution of it, for the inevitable result of gambling in stocks and shares is that the energies of so many of the people are directed into nonproductive, instead of into productive, channels. Industries which yield a safe and certain, though a moderate, return for the labour expended upon them languish, or are put on one side altogether, while those who ought to be steadily developing the country's resources, and in this way securing their own comfort and happiness, as well as the prosperity of their country, are deluding themselves by the vain hope that by means of some lucky hit or fortunate speculative adventure they may relieve themselves of the necessity of honest hard work in securing a livelihood. Where one succeeds in this hope hundreds fail, yet still the spirit of gambling keeps the hope alive, so long as speculation is rife in a country, and the loser of to-day may look forward to being a winner to-morrow. All this is now happily being changed, but the change is not being effected without serious loss to the community, aggravated and intensified by the disastrous failure of a trusted local bank, the Bank of Van Diemen's Land, whose shameful mismanagement has caused widespread suffering ruin to many in our midst; a suffering and a ruin of which the end has by no means yet been reached. Still there are prospects of better times before us. It is true that the wealth of the country, judged by the present selling prices of the land and by the market quotations of various securities and undertakings, has fallen enormously, but our resources are just what they were. The real wealth is with us all the same, and the bone and sinew to make it available and to put it into a marketable shape. I have already referred to the possibilities of expansion in your fruit trade, and in your agricultural industries generally. But the mineral wealth of Tasmania will, I feel confident, be a most important factor in restoring her prosperity. It is most cheering to note that during a period of almost unexampled depression, not only is the output from our mines increasing, but much of the increase is coming from new districts altogether. With the restoration of confidence brighter times must come. I must not be understood as implying that the periods of prosperity and depression of any particular country are wholly dependent upon what passes in that country, for the ramifications of commerce are world-wide. There is no doubt in my mind that the collapse of Baring Brothers, who had, I believe, very little direct Australian connection, was a powerful factor in bringing about the general depression from which we, in common with many other parts of the world, are at present suffering, and is it quite conceivable that the first movement in the direction of prosperous times for us may come from the other side of the globe. Even as I write this address, a new light is arising out of the darkness, which can be dimly seen across the broad Pacific. The altered policy of America, of which we are now being daily informed by cable, gives us good grounds for hoping that at no distant time a reduction will be made in the duties charged on wool and tin which the United States take from us, and that thus the demand for these staple productions of Tasmania will be largely increased. Then, again, we are all looking forward to a federation of these colonies. Many regard this as distant. I believe it to be near. But near or distant when it does come it will be an enormous benefit to Tasmania, and by affording increased outlets for our products will so add to our prosperity that our national debt will sit much more lightly than it now does on our shoulders.

In conclusion, it is not only the material prosperity of a country which is benefited and advantaged by the operations of a Society like this, and by the other educational influences to which I have referred. Such agencies also have a direct tendency towards the moral elevation of the community. They instil in us a love of truth, for truth's sake, and perhaps insensibly, but none the less surely, they raise our standard of political, commercial, and social morality. I wish all these agencies in this country God-speed. And now I must bid you all farewell. I thank the Fellows of this Society for their unvarying personal kindness and consideration towards myself. I thank you, Mr. Barnard, for the support, as Vice-President, you have always given me. I thank the secretary, Mr. Morton, for the excellence of his arrangements in all matters connected with our meetings, and with the work of the Society generally, and for reducing to a minimum the more or less formal work of the President. I thank Mr. Johnston for the assistance he has always so readily rendered me, not alone in matters connected with this Society. I congratulate Tasmania on having a man of Mr. Johnston's genius in her community, whose splendid work on her geology reflects credit alike on the author and on the country to which he belongs; and I congratulate this Society on having, as one of its members, a man of Mr. Johnston's power and knowledge, able and willing to render you yeoman service. It will always be a source of satisfaction to me that I have had the privilege of filling for so long a time the office of your President, and I will carry back with me to the Old Country few associations more pleasant than those connected with the Royal Society of Tasmania.

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NOTES ON THE NATURAL LIMITS TO OCCUPATION ON THE LAND.

By R. M. Johnston, F.L.S.

The number of persons that may be employed upon the land varies with the country, with the form of cultivation, and with the degree of civilisation. But whatever the civilisation may be, there are natural limits to occupation on the land which bar the introduction of more than a certain number. The natural conditions which principally determine these limits are:—(A.) The total extent of land surface of the particular country. (B.) The degree of fertility and the extent of land open to hunting wild animals, or gathering natural vegetable roots or fruits; cultivation for pasturage only; cultivation for either crops or pasturage. (C.) Knowledge and capital as factors in determining and employing the best methods for extracting the greatest amount of produce from a definite area. (D.) The absolute number of hands necessary to cultivate a given area in any form, beyond which limit human labour is wasted in fruitless effort or in positive idleness. (E.) The proportion of cultivable area already occupied. If, in addition, we employ the indices *m*, *e*, and *n* as indicating maximum, medium, and minimum of each condition, we may express by simple formulæ the conditions which determine the largest (D^m) and smallest (D^n) number of hands which can find occupation on the land; always assuming that their time is wholly occupied within the field of their own division of labour.

We are now able to express definitely the conditions which determine the *maximum* (D^m), *medium*, and *minimum* (D^n) number of hands that it would be necessary to employ upon the land according to the existing conditions under which agricultural and pastoral pursuits are carried on in the United Kingdom.

The Maximum number of hands employed upon the land could only occur under the following conditions:—

$$A^m \times B^m \times C^n = D^m$$

The Minimum number could alone be employed under the opposite of this condition, viz.:—

$$A^n \times B^n \times C^m = D^n$$

But it never happens that a country as a whole can devote all its cultivable lands to one form of cultivation, say, crops from tilled lands. The following proportions show what obtains in five great countries in Europe:—

PROPORTION PERCENTAGE TOTAL AREA IN CULTIVATION.

—	Tillage.	Pasturage.	All cultivated.	Hands per 100 acres in cultivation.
United Kingdom ...	43·56	56·44	100·00	5·38
France	86·96	13·04	100·00	7·17
Russia	39·23	60·77	100·00	7·88
Germany	58·40	41·60	100·00	12·19
Belgium	82·46	17·56	100·00	17·91
Five Countries ...	53·79	46·21	100·00	8·22

From this analysis we can perceive that there is a variation in the hands employed per 100 acres, ranging between 5·38 per cent. in the United Kingdom to 17·91 in Belgium. The tilled lands requiring a larger proportion of hands, account for the larger number employed per 100 acres in some countries; but against this must be placed the reduction in the hands employed, effected by the introduction of machinery and improved methods of culture—when all other things are equal. The space limit to occupation on the land, however, can only affect countries that are already densely populated and whose land area relatively is limited. Let us, therefore, apply this method to a particular country, say, the United Kingdom, for the purpose of ascertaining:—

1. The maximum number of hands that could find employment upon the land, supposing it was conceivable to bring the total area into cultivation.

2. The maximum number that could find employment on the more probable supposition that only 75 per cent. of the area could possibly be utilised.

3. The number of years in which the full limit would be reached supposing it conceivable to cultivate the whole area of the country including sites of dwellings in towns, villages, and cities, and lake and mountain areas.

4. The number of years in which the full limit would be reached, supposing it probable that no more than 75 per cent. of the total area could be brought under cultivation.

Then let A=Total area in acres = 77·80 million acres.

H=The number of hands required to cultivate each 100 acres according to existing conditions=5·35 hands.

R=Average natural rate of increase of Rural Population=say 1·25 per year.

C=The actual area already in cultivation in (1840)=43·80 million acres.

N=The number of hands already employed in 1840 in cultivating the land=3·400 million hands.

N^a=Ditto ditto in 1881=2·561 million hands.

The answers to queries 1, 2, 3, and 4 would be as follows:—

Query (1.) $\therefore \frac{AH}{100} = X$ or max. number of hands or =Ans. (1)=4·162 millions.

(2.) $\therefore \frac{\left(\frac{75\,A}{100}\right)}{100} \times H = Y$ or max. number of hands, or = Ans. (2) = 3·122 millions.

(3.) $$\therefore \frac{\log.X - \log.N}{\log.R} = \frac{\log.\ 4{\cdot}162{\cdot}000 - \log.\ 3{\cdot}400{\cdot}000}{\log 1{\cdot}25}$$
= 16·28 years or year 1856.

(4.) $$\left\{\begin{array}{l} \therefore \frac{\log.Y - \log.N^a}{\log R} = \frac{\log.\ 3{\cdot}122{\cdot}000 - \log.2{\cdot}561{\cdot}000}{\log.\ 1{\cdot}25} \\ \qquad = 15{\cdot}94 \text{ years, or year 1896.} \\ \therefore \frac{\log.X - \log.N}{\log.R} = \frac{\log.\ 4{\cdot}162{\cdot}000 - \log.\ 2{\cdot}561{\cdot}000}{\log.\ 1{\cdot}25} \\ \qquad = 39{\cdot}09 \text{ years, or year 1929.} \end{array}\right.$$

It has thus been demonstrated that the ordinary growth by natural increase of the agricultural population of the United Kingdom of 1841 (if migration was prevented by placing them on the land still uncultivated) would fully stock the whole of its land area of every description in 16·28 years later; that is in the year 1856, or 36 years ago. Starting with the agricultural population of 1881, the same rate of natural increase, under similar conditions, would fully stock 75 per cent. of its land surface in the year 1896, or four years hence; and even if we conceive what is impossible, that its total area was open to cultivation, this same natural increase would fully stock land occupations in the year 1920.

It is clear, therefore, that employment on the land in the United Kingdom is bound in within very narrow limits by space—one of the most formidable of all natural limits—and no alteration in the rate of remuneration of the agricultural labourer, nor improvement in his condition, can affect this limit in the slightest degree. But in addition to the space limit, the number of hands necessary to cultivate a given area, or produce a definite quantity of produce, there is a gradually contracting limit brought about by natural forces, such as steam, electricity, and improvements in labour-saving machinery. Thus the same area in 1881 was cultivated in a higher degree, and with better results, than in 1841, with a reduction in the hands employed equivalent to 31·06 per cent. Since 1841 the added force of steam, as an auxiliary to human labour in the United Kingdom alone, and there utilised in the transport of materials and in various other ways, is estimated to be equivalent to the manual force of 103 millions of workmen, or fully six times the manual force of the total number of breadwinners of the United Kingdom at the present moment. It is not surprising, therefore, that agricultural hands per 100 acres should have decreased from 7·76 in 1840 to 5·35 in the year 1881; and that these combined causes should of necessity compel a regular stream of migration from rural districts to urban centres or to other countries; and so long as a healthy condition exists in rural districts (unmistakably indicated always by a high rate of natural increase) such migration is inevitable. According to calculations made by Mr. Mulhall, in the United States 9,000,000 hands raise nearly half as much grain as 66,000,000 hands in Europe. Thus it appears that for want of implements or proper machinery there is a waste of labour in Europe equal to 48,000,000 of peasants. In other words, one farm labourer in the United States is worth more than three in Europe. This state of affairs in Europe, however, is altering for the better each year. Since 1840, owing to improvements in implements and machinery, tillage has become more productive, and grain has become cheaper. From the same authority we learn that "in 1840 each peasant produced about 75 bushels of grain; in 1860 the average was 87, and in 1887 it had risen to 114; that is, two men now produce more grain than three did in 1840." From these observations we are able to understand that a smaller number of hands employed in agriculture is no indication of smaller produce. Take the results of two periods in the United Kingdom, 1840 and 1887, and we at once perceive that the tendencies upon the whole are beneficial—not injurious.

—	1840	1887	Percentage Increase or Decrease since 1840.	
			Increase.	Decrease.
Total population Millions No.	26·71	57·08	38· 86	—
Agricultural hands ,, ,,	3·40	2·56	—	24·70
Other occupations ,, ,,	7·96	14·16	77·89	—
Total acreage under crop ... ... ,, Acres	22·00	21·00	—	4·55
Total under all forms of cultivation ... ,, ,,	43·80	47·88	9·19	—
Agricultural capital per hand ... ... ,, £	579	893	54·23	—
Agricultural products per hand... ,, £	65	97	49·23	—
Agricultural hands per 100 acres in crop... ... ... No.	15·45	12·19	—	21·10
Ditto per 100 acres in total cultivation ... No.	7·76	5·35	—	31·06
Wheat consumed per head ... ... lbs.	255	354	38·82	—
Meat consumed per head ... ... lbs.	87	109	25·29	—
Price of wheat per ton £	16·60	8·15	—	50·90
Capital wealth ... millions £	4,100	9,400	129·30	—
Horse-power of steam used as a motive power .. .. No.	600,000	9,200,000	1,433	—
Paupers per 1,000 persons ... ... No.	57·40	25·80	—	55·05

Nothing could more plainly reveal the general tendency of modern agriculture than these figures. It shows clearly, so far as the United Kingdom is concerned, that progress in improved modes of cultivation means:—Increased capital, increased products, cheaper food, increase of hands in other occupations, and a gradual decrease in the hands employed in agricultural pursuits, associated with a general decrease in the amount of pauperism. Employment upon the land, therefore, is lessened relatively by every advance made in the modes of culture, and is blocked absolutely so far as many populous countries are concerned by limits of space available for cultivation of any kind. Unless, therefore, a country like the United Kingdom takes a backward step in mode of cultivating the land, she cannot, while foreign products are of necessity admitted freely, place more than 5·35 hands upon each 100 acres in cultivation. No legislation under such conditions, made with the view of giving facilities for land ownership, can affect the numbers that may be employed. It is conceivable that the lot of the worker may by such means be ameliorated or improved, but legislation within a freetrade border cannot enlarge the field of employment for the agricultural labourer. Nor under any circumstances whatever can legislation increase the number of agricultural hands without loss and injury to the people as a whole.

In conclusion, let me not be supposed to indicate by these observations that the lessening numbers of persons employed on the land in such a country as the United Kingdom is to be regarded as a matter to be deplored. On the contrary, I regard it as an index of advance in civilisation. If the food and raw products necessary for man's needs and satisfactions could be miraculously produced without the agency of a single labourer, mankind would be enriched, not impoverished; for there would then be so much more labour force available for the creation of comforts and satisfactions, in such cheapness and abundance, that all men might possess and enjoy them in a degree now only possible to a few rich individuals. What is wanted, therefore, in countries passing through a transition of the kind referred to is, not to place any check upon free migration and other movements which now act as safety-valves to congested fields of labour, but rather to increase the facilities for transfer from those places and those occupations where pressure of competition for employment is greatest. It is the obstruction which natural and artificial barriers offer to transfer from blocked areas and blocked occupations that causes the so-called congestion of labour in crowded centres of population, and any discovery which would remove such barriers would mark a new era in the progress of civilised communities.

DISCUSSION.

Hon. N. J. BROWN, in speaking to the paper, said he could not presume to criticise the able and interesting paper they had just listened to. He would like to read it carefully before making any remark upon it, but as he had been invited to open a discussion of it, he would venture to express one or two ideas that had occurred to him on the spur of the moment. There was just one point which it seemed to him Mr. Johnston had rather omitted to give prominence to, and that was the competition which a country like Great Britain, and he might say other European countries also, had to contend with, more especially in recent years, by the employment of labour sustained at a very small expense as compared with the labour in the countries he had more especially dealt with. Any change in the direction of increased cost of production of cereals abroad would surely increase the quantity that could be profitably produced at home; and, consequently, the number of people employed in such production. There was no doubt, looking at the matter broadly, that there was prevalent a very great delusion in the minds of very many people who were not acquainted with the conditions under which land was cultivated as to the extent to which it might be profitably occupied, and if so far the paper read would have the effect of dissipating that illusion, he was quite sure Mr. Johnston would have done good service not only to this community, but to other communities also. There was no doubt a feeling abroad which was expressed by a prominent politician some two or three years ago that the salvation of the working population of Great Britain might be worked out by presenting each labourer with three acres and a cow, and he thought that one object of the paper was to some extent to remove delusions such as that from the popular mind. They knew that in this colony in past years it had been exceedingly profitable for people to take up 200, 300, or 400 acres, and devote themselves exclusively to the cultivation of grain. But other conditions had now come in with the cultivation of the soil in the other colonies, and therefore they found a great deal in what Mr. Johnston had said which could be brought home to themselves. One other point he would like to mention in connection with this subject. He referred to the fact by the increase of population it is estimated by a reliable authority the world required annually an increase of 30 millions of bushels of wheat, and as the production of wheat was gradually falling off, owing to the continued reduction in price, it was thought by those competent to judge that within the next few years there would be a considerable increase in the price of wheat. If that were so, and the calculation he had mentioned rested upon a solid foundation, it certainly must to a very considerable extent modify the views which Mr. Johnston and others took as to the prospects of the cultivation of land for the production of cereals even in the United Kingdom. He would only add that their cordial thanks were due to Mr. Johnston for introducing the subject to their notice, and for the manner in which he had dealt with it.

Mr. JOHNSTON pointed out, in reply, that what he spoke about was the natural limits to the occupation of the land. Of course, the space limit could not apply to these colonies, and he hoped it would be very long before it could apply here. It was in England, and places of a like nature, in which the space limit, as a factor, comes immediately into operation in determining the number of hands that may be employed on the land. With regard to the proposals to give each agricultural labourer a bit of land to cultivate for himself, and so augment his income obtained otherwise by working for large farm employers, he hoped it might ameliorate his condition, but he feared that he could not permanently retain this advantage, as the tendency of competition would make this very advantage a lever to depress ordinary wages.

HIS EXCELLENCY, in moving a vote of thanks to the gentlemen who had contributed papers, said he had listened to very many interesting papers, but he did not think he ever listened to any paper with such interest as the one delivered by Mr. Johnston. It was a subject he had thought a good deal on himself. He had never heard or seen it treated in the same way as Mr. Johnston had done, and he hoped when completed the paper would have a very wide circulation indeed. In an article in a recent number of the *Nineteenth Century*, Mr. Johnston referred to the point slightly; but he had dealt with it that night in such a strong way that he had really advanced the scientific basis of the subject. Of course, there was a great deal to be said on the other side; but he held that Mr. Johnston had really taken a step forward in the consideration of the subject. As regarded Mr. Taylor's paper, he was sure they had all listened to it with great interest. The explanation he had given was very clear, and he had no doubt his object would be fulfilled if the general attention of the mining public was directed both to the advantages and drawbacks of this description of timbering. (Applause).

WHAT ARE THE CONDITIONS WHICH DETERMINE THE JUST AND EQUITABLE REPRESENTATION OF THE PEOPLE?

By R. M. Johnston, F.L.S.

To secure a just and equitable representation of the people in Parliament is a matter which has at all times engaged the attention of thoughtful, practical legislators, and of great thinkers. That the idealist should be far in advance of the practical legislator is what we must naturally expect; for in their ideal schemes of "The Best Form of Government," or "The Best Form of Representation," the former may easily overlook or surmount obstacles by assumptions which are not open to the practical legislator who attempts to reduce any ideal to practice. If knowledge and justice were synonymous, there would be less difficulty as regards the attainment of an ideally perfect representation, for this might be secured by basing the electorate upon some common fixed minimum standard of education. But the practical legislator cannot entertain this dream, for his experience has too well taught him that selfishness and injustice are not eliminated by greater intelligence, nor is the sense of justice necessarily absent where the intelligence is small. An education standard, therefore, only helps us a very little way towards securing a basis for the formation of a just representation of the people. Indeed, another chapter in history is no longer necessary to us to demonstrate that the great barrier to just representation in the future is *immediate self-interest*, not *ignorance*. Self-interest is not always base, in the sense of being restricted to the individual, although it is always distinguished as the centre of those graduated rings of sympathies and interests which are in greatest harmony with those of the individual. These rings of sympathies, however, are themselves variable and complex, and sometimes conflict with each other.

The interests and sympathies which most strongly affect all individuals in common are approximately related to the individual in the following order, which, in a general way, correspond with a diminution of intensity, viz.:

					PUBLIC INTERESTS.
1.	FAMILY	INDIVIDUALS OF THE FAMILY GROUP.			Invariable, and simple within the Family Group.
2.		FAMILY.			Practically the same.
3.		HEAD OF FAMILY.			Ditto, ditto.
4	NATIONAL	Locality Interests.	Class Interests.	Moral Sympathies.	Interests variable and often conflicting in the same individual.

From this analysis we perceive that an ideally just representation of the people must be based upon the family, whose interests from a social point of view are in common, and are usually centred in *one* person, who by nature and affection stands as their natural guardian and representative to the outer world. At this stage the *foe* to just representation at a later stage is rendered comparatively harmless by the short range yet locally dominating altruistic attributes, such as the spontaneous love, affection, friendship, or powerful sense of duty, always more or less active, either in subduing the narrower forms of selfishness within the family group, or in so modifying its influence as to become beneficial, not harmful, to the family interest as a whole.

Any scheme of representation, therefore, which would aim at penetrating the solidarity of the family by proffering separate electoral rights to each of its existing component members would do more harm than good, for it would destroy the true foundation upon which good government rests, viz., the altruistic virtues evoked and fostered within the family circle. The question of *Female Suffrage* is reduced to a small compass when considered from this point of view.

The natural guardian of each family is also, as a rule, the breadwinner, and therefore the *naturally elected* representative of the dependent wife, child, or relative. It is manifest also that artificial representation should only begin where natural representation ends, *i.e*, in the natural representative of the *family*. It excludes the dependants, not merely because they are females, or because the male dependants are under 21 years of age, but mainly because all such are naturally comprehended in their natural representative—the householder. There is no artificial determination of what constitutes a householder. Whatever natural condition exists which calls one person out to be regarded as the head of the family group suffices—whether it be the father, widowed mother, elder brother, or elder sister—so long as such one is regarded by the family group as the nominal head or guardian. The natural unit of the electorate of any population is the "Householder"—not "males 21 years of age and over." The males of a population, 21 years of age and over, as such have no natural right to be singled out from women and children as representative electors of the community other than the savage one of being the *stronger*. Of course there are reasons, if not rights, why single men of 21 years and over may have some claim to electoral privileges, *e.g.*: 1. They may not be represented by any natural guardian or householder. 2. They may be independent breadwinners, and thus independently contribute to the taxation necessary for the government of the country. 3. *They may specially be drawn upon to defend the State in the case of war or disturbance* *to the peace of the community*. But the two first reasons also apply to all single adult female breadwinners, who are neither householders nor represented by natural guardians. It is the third reason which alone gives a special claim to single adult male breadwinners who are neither householders nor represented by any natural guardian. Still the grounds upon which their title to vote as electors rest are much inferior to householders who are also natural guardians and representatives of the greater half of the population. The former are units, which represent themselves *alone*; the latter not only represent themselves, but also represent on the average from two to three dependent persons, the support of whom correspondingly increases the amount of taxation which each householder contributes to the support of government. If, therefore, the single adult breadwinner has a legitimate claim to be an elector, the householder's claim is at least three-fold greater.

From what has been observed it is manifest that each electoral district should be represented in Parliament as nearly as practicable in accordance with the number of its population rather than with the numbers of electors, as urged by some. This, however, is a purely theoretical consideration; for in a general way the electors of a given district are nearly in the same proportion to all electors as its population is to the total population. But in exceptional cases, where it is not so, the population base for equitable representation has a much greater claim than the electoral base. There are other considerations why the *population quota* is preferable to the *elector quota* in determining the representative value of any electoral district. Many electors have votes for more than the one district in which the elector and his family resides. Such an one cannot be placed upon equality with the resident elector whose whole interest, including his dependants (non-electors) are bound up in the particular district. The non-resident elector element in the *elector quota*, therefore, destroys its value, and strengthens the grounds upon which representation by *population quota* is sustained. But some may still urge the old fallacious plea, Has property no just claim to representation? So far as the general government of a new country is concerned, the interests of property-holders are quite as varied and conflicting as the population interests *per se*, and the population of a particular district has more interests in common with the property interests within its border than have the property interests of different districts with each other; *e.g.*: The burning question in young colonies is the development of its lands and industries rather than incidence of taxation, and the aid of the General Government in the construction of roads, bridges, harbours, railways, telegraphs, etc., is the rock upon which the interests of property, and people alike, split up into rival interests. The interests of the locality in young colonies are therefore upon the whole the dominating ones; and in these conflicts the local interests of population and property are in unison so far as local matters are concerned, and together they are in rivalry with similarly combined interests of other localities. Moreover, it must be borne in mind that it is only in matters relating to Municipal Government that property, as such, has a just claim for special consideration in matters relating to representation.

The whole of the advantages secured in urban communities under Municipal Government may include Water Supply, Formation and Repairs to Streets and Footpaths, Sanitation, Protection to Persons and Real and Personal Property, Parks and Recreation Grounds, Street Lighting, etc. The enjoyment of all such benefits may be said to be equally distributed to each member of the community. That is, no matter whether any one person of the community pays little, much, or none of the taxation necessary to provide for most of these common benefits, each individual has the enjoyment of them *equally*. It is therefore reasonable that some extra share of the control and distribution of such common advantages should be placed in the hands of those who individually contribute the greatest share of the taxation necessary to provide for them.

Without such a safeguard it is conceivable that the luxurious demands of a majority who pay little or nothing towards their provision and maintenance might, by an extravagance which does not touch their pockets, almost ruin the minority, who are forced to defray the expenditure.

Having touched upon three distinct considerations which are somehow to be taken into account (Population, Electors, and Property) in the determination of any just and equitable representation of the people, it has been shown that so far as the functions delegated to a General Government are concerned, the best form of representation should be based rather upon the population quota method than upon either the elector or property quota, or upon any combination of these. It is advantageous, however, to show that population *per se* is not only theoretically the fairer method, but from the nature of things it fundamentally determines the number of electors as well as the amount of property. For whatever differences may be shown by individual districts from one another, on the whole, the population quota to the total population will yield for nearly all districts the same representation as the elector quota does relative to the total number of electors, or as the property quota does relative to the total amount of property. Indeed, broadly speaking, the number of the population is not only the fundamental cause or root of the dimensions of the other two categories, but it may be safely taken as a unit measure or index of them. This is significally illustrated by the following contrasts with respect to the principal divisions of Tasmania, taking a common division (40) for determining the respective quotas:—

—	Absolute.			Proportion per Quota.					
—	Property Capital Value.*	Electors. No. †	Population. No. †	Property.	Electors.	Population.	Mean of Three.	Mean of Electors and Population alone.	Mean Approx. Population.
	£								
North-Eastern Division...	6,603,969	9,792	47,664	11·86	12·71	13·00	12·52	12·85	13
North-Western Division...	3,270,802	6,051	27,213	6·06	7·85	7·41	7·11	7·63	7
Midland Division ...	4,521,300	2,737	13,406	8·37	3·55	3·67	5·19	3·61	4
South-Eastern and South-Western Division ...	7,406,762	12,237	58,384	13·71	15·89	15·92	15·18	15·91	16
TOTAL	21,602,773	30,817	146,667	40	40	40	40	40	40
Quota 1-40th	540,069	779	3,667	1	1	1	1	1	1

* 1890. † Census Year 1891

Practically the proportion per quota of electors and population yield the same result in the detail representation for each sub-division; and the proportion per quota of property is remarkably close upon the whole.

Nay, so far as urban populations are concerned, the proportion per quota yielded by Property, Electors, and Populations invariably shows the very closest correspondence, thus:—

—	Absolute.			Proportion per Quota.			
—	Property Cap. Value.	Electors. No.	Population. No.	Property.	Electors.	Population.	Mean Approximate Population.
Hobart ...	3,134,539	5,237	24,905	5·80	6·80	6·79	7
Launceston	2,768,501	3,746	17,208	5·13	4·86	4·69	5
Both ...	5,903,040	8,983	42,113	10·93	11·66	11·50	12
Quota ...	540,069	779	3,667	1·	1·	1·	1

Representation of Localities

Having disposed of the question regarding the best method to be adopted for securing a just and equitable representation of the people, there is still a most important end to be secured, viz., a just and equitable representation for distinct localities. For it may readily be conceived that, although each individual of a quota had an equal voice in the selection of the Parliamentary representative, their *locality interests*, by the bad grouping of the boundaries or limits of the electoral district, may be so conflicting as to deprive the electors of power to give effect to them; or, what is the same, their representative would be so hampered by rival suggestions, destructive of each other in regard to locality interests, that he would be powerless to take any action in Parliament in respect of either rival interest.

This is more readily appreciated when we remember that each elector is governed by at least three primary interests, which often conflict with each other in respect to his own individual choice, viz.:—

1. Religious, Moral, and Intellectual Interests and Sympathies.
2. Trade or Calling, or Class Interests and Sympathies.
3. Locality Interests and Sympathies.
4. Personal Sympathies.

It may so happen that during the conflict of one election his mind may be dominated by the first of these, as in the case of the present elections in Ulster, *i.e.*, by religious sympathies. At another time class interests may dominate, as when the question of the day turns upon the relations between Capital and Labour. Again, if the burning question of the day turns upon rival routes for railways, or for the fair claims of the district to a share in the expenditure for the construction of roads or important public works, the locality interests of the individual electors may for the time being become the dominant ones in determining his action or choice. The definition of electoral boundaries, however determined, and so long as they are fairly represented on the basis of population, do not involve serious difficulties to the individual elector in exercising his influence upon the Central Government with respect to his various and variable interests, if we except the interests of locality.

To afford the individual the full force of his electoral privileges in respect of locality, it is necessary that the interests of all electors within any distinct electoral area should be in harmony, *i.e.*, that no important portion of the district should act as a dead weight owing to its locality interests being on geographical or other grounds more identified with some neighbouring electoral district than with its own.

How to secure fair representation on the basis of numbers whilst still preserving intact the solidarity of locality interests is the great' problem which the practical politician has to solve; and it is a problem which is surrounded with many more practical difficulties than any of the schemes for representation which are confined to the representation of the person alone. It would not be difficult to divide the country into distinct electoral districts, whose locality interests are fairly identical, solely upon some physical or geographical basis. Nor would it be a difficult matter to cut up the whole country into electoral district units on the basis of population alone.

The practical difficulty only appears when we try to obtain an electoral district unit of representation which will fairly coincide with both of these important considerations.

As a matter of fact, the perfect attainment of such an ideal is utterly impossible. To secure one of its important aims rigidly would in most cases only be attained by the sacrifice of ideal fairness in respect of the other. Fairly perfect units coinciding in both aims would be purely accidental, temporary and exceptional.

Let us examine this matter a little more closely.

Locality interests should mainly be determined by the following circumstances:—

DESIDERATA, OR PRINCIPLES.

1. **The interests of the principal industries carried on within the district are not of a conflicting character, *i.e.*, they are mainly Agricultural, Pastoral, Mineral, or Industrial, as the case may be.**
2. **The main channels of communication by Road or Rail are common to the particular sub-divisions contained therein.**
3. The minor or Road Districts included within the district are so far harmonious that they meet in common in the trunk system of the particular Electoral District.
4. The centre or centres for the administration of justice, law, protection, and registration within the district are more convenient to all its sub-divisions than to the corresponding centres of neighbouring Electoral Districts, allowance being made as regards the borderlands, especially of Rural Districts and Urban Districts, where it must ever happen that the inhabitants of a Rural District Boundary *touching* an Urban District Boundary are nearer, or as near, to the Urban centres than to those of their own.

These are the principal conditions which determine the nature of an ideally perfect electoral district based upon locality interests.

The conditions which are demanded by representation on the basis of population are, that every electoral district shall, as nearly as possible, contain one quota of the total population, or in exceptionally populous geographically undivided districts two or more *complete quotas!*

But the density of population of many large distinct geographical areas is so small that it would require to unite as many of them as would cover an area of 3,280 square miles (Franklin) to enable us to satisfy the claims of fairness of representation on the basis of numbers, that is, one quota of the total population; while others (Hobart city) are so dense that 1·98 square miles embraces as many persons as would fairly constitute seven complete quotas. But how are we to reconcile two rival claims for distinct representation, one of which we may call the geographical unit, is rigidly fixed for all time, and the other—the population unit—which varies each day in accordance with the actual changes brought about, naturally by births and deaths, and artificially by constant movements of the population to or from old or new centres of population? Even if we could fix an exact and coincidentally fair representation for all districts at any one moment, such is the variableness of growth or decline ever going on in various districts that it would certainly be out of perfect harmony in both respects within the space of a few weeks.

It is clear, therefore, that the ideal of a perfectly exact and fair representation on the basis of distinct natural geographical units and single population or electoral quotas is practically unattainable, and therefore any objections that may be put forward *on such grounds* to any scheme of representation whatever, will in itself be no conclusive evidence against or for such a scheme, whether good or bad. It will only amount to a truism expressive of the fact *that the impossible has not been achieved.* It is, however, practicable to attain a fair approximation to our ideal in both its important aspects if the two standards of fair and equitable representation be used as tests for measuring the relative value of different plans which most nearly satisfy their claims.

The following are the principles by which a fair and just scheme of Representation may always be preserved, which unites the distinct claims of the solidarity of distinct geographical units with those which rest on the claims of numbers:—

PRINCIPLES.

1. Preserve all Geographical Districts as Single Electoral Districts, whose population does not exceed or fall below the population or Electoral quota by 25 per cent.

2. Unite two or more sparsely populated but distinct Geographical Districts, so that combined they approximate to a full Electoral quota.

3. Where two contiguous Geographical Districts already constitute two single Electoral Districts, only give two Representatives taken separately, but if united would represent three quotas nearly.—Unite the two to form a single Three-member District, with the consent of the Representatives of the original districts in cases where it is impracticable to form a third separate district whose boundaries would not transgress in matters essential to Locality Interests.

4. In fixing the total number of Representatives leave a margin in the aggregate, so that from time to time a single member may be added—in case of a new centre springing rapidly into existence, or an old one suddenly expanding—without any disturbance to other districts, which comparatively may be unaffected in their relation to the Electoral quota—*e.g.*: If the normal number be determined to be 40, fix the standard thus, "not less than 40 and not exceeding 44."

5. In areas that are progressive do not add an additional member for excess of quota until it reaches at least 75 per cent. of the full quota.

6. In declining areas do not cancel the representative of a geographical unit or Electoral District until the deficiency below the quota falls below it by 40 per cent. of the said quota.

7. Where two contiguous Electoral Districts exist, one decreasing in numbers and the other making a corresponding increase, adjustment may be preserved in relation to quota either by amalgamating the two as a single Two-member District, or if not infringing upon the solidarity of Locality Interests of one of them, annex one or more of the complete sub-divisions—say Road Districts—to the smaller population, where it would produce the desired distribution of population.

8. As Local Taxation is levied on the basis of Assessment Rolls relating to Road Trusts and Municipal Districts, and as Population Statistics are obtained in relation to Registration Districts, it is absolutely necessary for determining the Population, Amount of Property, and Trade and Industry of any Division, whether Electoral, Municipal, Registration, or Road Trust, that there should be a systematised plan of harmony between the smaller and the larger divisions.

In urban districts the municipal area should be a multiple exactly of the electoral unit. In rural districts the municipal area should be an exact multiple of complete road district divisions plus its non-road district area regarded as one of the units: and the municipal and electoral district should be so related that the larger of the two should be an exact multiple of the other. The registration district should be identical with one or more multiples of some of the aforesaid divisions. In this way information relating to Population, Trade and Industry and Property obtained by any of the modes now in operation could be readily related to any of the several forms of district groupings. The grand principle of harmony of districts being that the larger division boundary should *coincide exactly* with the corresponding outermost limits of the lesser but complete divisions contained within it. Negatively it may be stated as follows:—

(*a.*) Any Road District should not form parts of two or more Municipal Districts.

(*b.*) Any Municipal District should not form parts of two or more Electoral Districts.

(*c.*) Any Electoral District (Urban Centres perhaps excepted) should not form parts of two or more Municipal Districts.

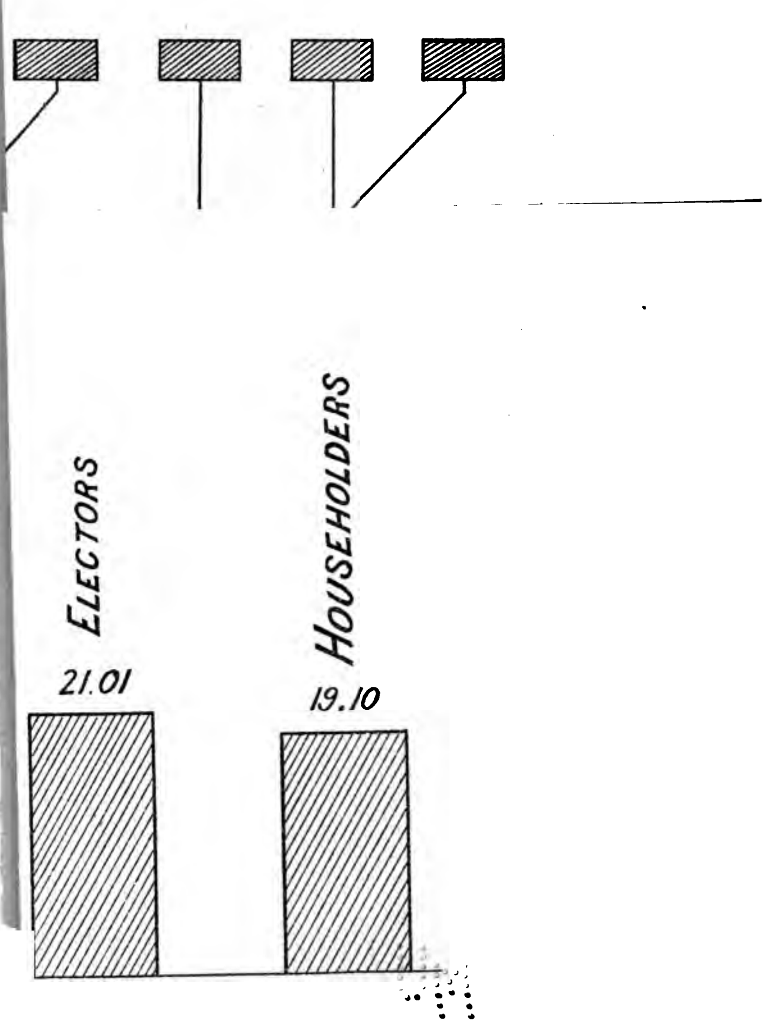
To secure with greatest economy the valuation of property or the state of any industry, the Rolls or Shedules should not be based solely upon the alphabetical order of either streets or names of persons (occupiers), but rather the alphabetical order should be subordinate to one of the smaller systematic sub-division of municipal districts, thus:—

PLAN of MUNICIPAL or POLICE ASSESSMENT ROLL.

ALPHABETICAL ORDER.	ROAD DISTRICT.	ELECTORAL DISTRICT.	MUNICIPAL DISTRICT.
Names.			SUMMARY.
a			Electoral District x.
b	A		Road District A...
c			„ „ B...
Total.........			„ „ C...
Names.			
a			Total Electoral District x ... ...
b	B	x	
c			
Total			Electoral District y.
Names.			Road District D ...
a			„ „ E ...
b	C		„ „ F ...
c			Total Electoral District y ... ...
Total.........	Total		
Names.			
a			
b	D		
c			
Total..			
Names.			
a			
b	E	y	Grand Total ... Municipal District
c			
Total.........			
Names.			
a			
b	F		
c			
Total.........			

If a scheme of representation satisfies all these conditions, it is the best scheme which is practically attainable, and is not defective from this point of view, even when it may show in many instances a considerable departure from the ideal standard of perfection.

PEOPLE. —



REMARKS ON SIR ROBERT BALL'S PAPER (READ AT THE HOBART MEETING OF THE AUSTRALASIAN SCIENCE ASSOCIATION), ENTITLED: "THE ASTRONOMICAL EXPLANATION OF A GLACIAL PERIOD."

By A. B. Biggs.

Of the many interesting papers that were read in the Astronomical Section of the recent Science Congress, by far the most interesting to me, and probably to the majority of those who listened to it, was that with which we were favoured by Sir Robert Ball, and which was read by His Excellency, Sir Robert Hamilton.

In the paper referred to, Sir John Herschel is accused by the author of having made, in his "Outlines of Astronomy," "a curiously erroneous statement:" that "Herschel wrote down hastily a statement which was quite wrong," and that Croll and others had been misled by Herschel's mistake.

It was startling to me to find two men of such eminence in Astronomical Science at variance with reference to a comparatively simple astronomical fact. Sir Robert Ball announces, as the object of his paper, "to indicate clearly the character of the error . . . and to substitute for it the correct mathematical theory." So that he is very emphatic upon the subject of the supposed mistake.

I did not feel myself in a position to criticise the paper at its reading, even had I the temerity to attempt it. I needed to study it at leisure before venturing on so bold a step. The receipt of a copy from the General Secretary of the association has put me in a position to look into the matter more closely.

The purport of Sir Robert Ball's paper is to show that the successive periods of glaciation, alternating with periods of genial or tropical temperature, which geologists infer from the indications of the rocks and strata, are a necessary corollary from astronomical data. It will be well then, as a preliminary, to state as concisely and clearly as I possibly can what are the conditions of the problem, which I take to be the following, every one of which is essential to the conclusion arrived at:—

1. That the earth's orbit is not a circle, but an ellipse, the sun's position in relation thereto being, not in the centre, but in one of the foci of the curve; consequently there are two opposite points at which respectively the earth is nearest to,

and farthest from the sun (Perihelion and Aphelion), these points being reached at the beginning of January and the beginning of July.

2. That a bisection of the orbit by a line through the sun's centre in any direction but that of coincidence with the major axis of the ellipse will cut the orbit into two unequal divisions, of which that which comprises the perihelion will receive the greater intensity of heat, in accordance with the law of inverse squares of distance.

3. Nevertheless, as the earth's angular velocity is in the same ratio of inverse squares of distance, the *total amount* of heat received in the one division of the orbit (and of the year), will exactly equal that received in the other division. Further, the year's supply will be equal in the two hemispheres.

4. That owing to the disturbing attraction of the planets (Venus and Jupiter principally), a slow variation is produced in the length of the minor axis of the earth's orbit, the major axis remaining constant. This amounts to saying that the eccentricity varies. This variation oscillates within certain limits, and occupies an enormously long period.

5. As a further effect from planetary perturbation, the direction of the major axis undergoes a slow progressive change, making a complete revolution in about 110,000 years.

6. That the moon's attractive force upon the earth's equatorial protuberance causes a gyration of the polar axis in a circle of 47 degrees in diameter, and the consequent revolution of the line of the equinoxes in the comparatively short period of 25,000 years.

7. The movement described above (6), known as the "precession of the equinoxes," and the revolution of the major axis of the orbit (5) being in opposite directions, it follows that they will recur to the same relative positions in the shorter period of 21,000 years.

8. The elementary fact of the inclination of the polar axis to the plane of the orbit at an angle of 66½ degrees must be takent into account. Upon this, and this only, depends the relative distribution of the total yearly supply of heat between the summer and winter seasons of the year in either hemisphere. This is shown by mathematical formulæ to be in the ratio of 63 to 37 nearly, *which ratio remains constant under all circumstances.*

There is still one other condition, as laid down by Sir Robert Ball, equally essential, but which I will postpone for the present, and will proceed to discuss the bearing which the foregoing postulates have upon the problem.

It must be evident that, at enormously long intervals (as we judge of time), the combined effects of the conditions above enumerated must be at a maximum as regards the relative *intensity* (as distinguished from *total amount*) of summer and winter heat. This will be when the eccentricity of the orbit is at its maximum, and the relative movements indicated in Nos. 6 and 7 have brought the line of the equinoxes at *right angles* with the major axis, thus cutting the orbit into its shortest possible perihelion, and longest aphelion divisions. That hemisphere, then, which has the perihelion summer will have its summer portion of heat (see No. 3) concentrated into a short and intensely hot summer; whilst its winter portion will be spread over a long, cold winter. At the same time the reverse of this will prevail in the other hemisphere. These conditions will alternate between the two hemispheres in the mid interval of 10,500 years.

I must now add, as No. 9, a further condition as laid down by Sir Robert Ball, which is, that "the sunbeams in the brief and fiercely hot summer of the glacial period *fail to melt as much ice as had been accumulated during the preceding winter.*" If this statement is correct, it must be admitted, I think, that the theory is established beyond question. If, on the other hand, it be not correct, and that the intensity of summer heat compensates the prolonged coldness of the winter (and this is the only point that is not quite clear to my mind), the theory breaks down utterly, even though all the other conditions remain intact.

The point on which Sir John Herschel is challenged by Sir Robert Ball is contained in the concluding sentence of condition 8. Sir Robert Ball puts the case as against Herschel thus (I cannot well shorten the quotation) :—

"Suppose that the total heat received from the sun on one hemisphere of the earth during the course of a twelvemonth be represented by 100, we proceed to consider how these parts are shared between the seasons. I mean by 'summer' in the Northern Hemisphere the interval from the vernal equinox to the autumnal, and by 'winter' the interval from the autumnal equinox to the vernal. With this understanding 63 parts of heat are received on each hemisphere during its summer, and the remaining 37 parts during the winter. . . . Herschel's erroneous statement was to the effect that *the heat was equally distributed, so that* 50 *parts were received in summer and* 50 *parts in winter.*" (All italics are mine unless otherwise indicated.)

Now, the question is :—Is this just what Sir John Herschel said or meant to say ? The passage on which Sir Robert Ball founds his charge can be only that on page 333 of the

5th edition of Herschel's "Outlines of Astronomy," which runs thus:—

"Supposing the eccentricity of the earth's orbit were very much greater than it actually is, the position of its perihelion remaining the same, it is evident that the character of the seasons in the two hemispheres would be strongly contrasted. In the Northern we should have a short but very mild winter, with a long but very cool summer,—that is, an approach to perpetual spring; while the Southern Hemisphere would be inconvenienced and might be rendered uninhabitable by the fierce extremes caused by concentrating half *the* annual supply of heat into a summer of very short duration, and spreading the other half over a long and dreary winter, sharpened into an intolerable intensity of frost when at its climax by the much greater remoteness of the sun." (Mark, "*the* annual supply," not *its*, etc.)

It must be admitted that, on a cursory reading, and taking it apart from its context, the above passage would appear to bear only the construction which Sir Robert Ball puts upon it. But is it fair, so to take it, or to take any man's utterances? Herschel has just been taking great pains to make clear the fact that (dividing the year and the orbit each into its—at present—two unequal portions by the equinoctial diameter of the orbit), though the earth is nearer the sun during the (northern) winter portion of the year than during the summer portion, and is consequently receiving a greater intensity of heat (according to the law of inverse squares of the distance), the earth's angular velocity being in the same ratio, the shortness of the season exactly compensates the intensity of radiation. He sums up the case thus:—

"The momentary supply of heat received by *the earth* in every point of its orbit varies exactly as the momentary increase of its longitude, from which it obviously follows that equal amounts of heat are received from the sun in whatever part of the ellipse those angles are situated. Supposing the orbit, then, to be divided into two segments by any straight line drawn through the sun, since equal angles in longitude (180 deg.) are described on either side of this line, the amount of heat received will be equal. In passing, then, from either equinox to the other, the *whole earth* receives equal amount of heat," etc.

Now take this quotation in connection with that to which Sir Robert Ball takes exception, as quoted above, and I think Herschel's meaning will be apparent, although in this case it must be admitted that he has failed to express himself with his accustomed preciseness. His statement is that "the hemisphere would be inconvenienced . . by concentrating half *the*" (not *its*) "annual supply of heat into a summer of short duration," etc., which is of course apportioned between the summer of one hemisphere and winter of the other alternately, and he can only be referring to that portion of this "supply" which pertains to the summer or winter of either hemisphere. That he could have meant nothing else is still more evident from a further quotation (page 230), in which he admits the unequal distribution of heat between summer and winter:—"Whenever, then, the sun remains more than 12 hours above the horizon of any place, and less beneath, the general temperature of that place will be above the average; when the reverse, below;" that is, the summer and winter portions of the year respectively.

The extent of the inequality of the distribution of the annual supply of heat between the summer and winter portions of the year in either hemisphere depends (as I have said) wholly and solely upon the inclination of the earth's axis, and no one could be more cognisant of this fact than Sir John Herschel. Assuming extreme conditions, the inclination of the axis, instead of being some 66½ deg., might have been zero, that is, coincident with the plane of the ecliptic, in which case the distribution of summer and winter heat (the yearly total), in either hemisphere (employing Sir Robert Ball's formula), would be as 818 to 182. On the other hand, the inclination might have been 90 deg., that is vertical, when there would have been no inequality, and the distinction of summer and winter would vanish. The inclination being actually between these two extremes (that is, 66½ deg.), the relative summer and winter heat supplies must lie between the aforesaid ratios, and is no doubt correctly stated by Sir Robert Ball as 63 to 37.

Of the geological aspect of the question I do not deem myself competent to speak; but, admitting the deductions of geologists as to the alternations of extreme heat and cold in the geological history of the earth, and the correctness of Sir Robert Ball's dictum with regard to the inefficiency of the extreme summer hear to dissipate the glacial effects of the preceding winter's cold (No. 9), the theory discussed by Sir Robert Ball is, I think, the only one yet propounded that will bear investigation.

ON THE PROPOSED LEAKE SCHOOL OF PRACTICAL ASTRONOMY.

By H. C. Russell, F.R.S., C.M.G., Government Astronomer of New South Wales,

Corresponding Member, Royal Society of Tasmania.

During my visit to Hobart in January last I was struck with the brightness and translucency of the atmosphere, and it was evident to me that the weather of the fortnight I was in Hobart would have enabled me to do as much as I had done in Sydney during the preceding two months. And, in conversation with some friends, I expressed regret that such fine skies for the Astronomer should not be taken advantage of, and an Astronomical Photographic Observatory established. I was told that Tasmania, like other parts of the world, was passing through a period of commercial depression, and the Government did not seem to be disposed to add to expenditure by starting an Observatory, but that the late Mr. Leake had left a sum of £10,000 for the foundation of a School of Astronomy, and it was hoped that an Observatory would be established very soon.

And it seems to me most fitting that the colony in which this noble bequest was made should be the first to take it up and benefit by its provisions; and the establishment of a Tasmanian University will, with the co-operation of the Senate, enable the trustees to carry out in a most satisfactory manner the wishes of the testator, who indeed seems to have contemplated such a natural combination as that now proposed between his trustees and the Senate of the University for the establishment of a School of Astronomy.

Such an addition as this to the functions of the University would be an immense advantage. In the first place, it will add to the curriculum another subject which students may take up, either as technical education or as a most valuable mental training in a general course of study. Next, it will induce some students to come to the University in order to attend the lectures on Astronomy, and if provision is made for non-matriculated students to attend the teaching in practical Astronomy on payment of fees, there can be no doubt that many will enrol their names.

The desire to contribute in some way towards the consummation of the proposed Observatory scheme, which seems to me so desirable, and so easy of attainment with the means at command, has induced me to make the following suggestions;

but before going on to these, I may point out that Hobart, in addition to its clear atmosphere, possesses in its high southern latitude a great advantage over any other available place for the new Observatory in the Southern Hemisphere. It is true that a slightly higher latitude is available in New Zealand, but the climate is less favourable, and the means to build an Observatory are apparently not forthcoming, and if one were erected in New Zealand it would no doubt be at Wellington. So that, practically, Hobart not only possesses the means, but also the best available site in the Southern Hemisphere for the Leake Observatory.

The extreme south part of the Milky Way is for the Astronomer an almost unexplored mine of wealth, and he will be in the best position to acquire the gems which it contains who has the greatest southern latitude for his instruments, because these parts of the heavens will come nearest to his zenith, and therefore suffer least by the Astronomer's greatest enemy, the impurity of the atmosphere. Admitting, then, the advantage of position, about which there can be no doubt, it may be pointed out that the time is opportune, and to establish the Observatory now would be gratifying to Astronomers generally, because the complete scheme for carrying out the work arranged by the Astronomical Conference in Paris, in 1887, according to which 18 Observatories agreed to divide the work of making a photographic chart of the whole heavens, has been to some extent marred by the political troubles in South America, owing to which three Observatories there have been unable to take up their part of the work. And the question is pressing upon the general committee in Paris,—How shall that portion of the photographic work which South America undertook be provided for? Under these circumstances the establishment of an Observatory to take up even a part of the work, would, by that fact alone, be brought into immediate prominence and earn the good wishes of all Astronomers.

But, in addition to the honour which would come in this way to Tasmania, if the work is undertaken by the University in co-operation with the Leake trustees, as I understand is proposed, the University of Tasmania will be the only one in Australasia having a complete School of Astronomy; that is, one in which the theory and *practice* of the science are taught, and it is natural to expect that students who want to take up the study, either as a mental culture, or with the object of making use of it practically in surveying or in a private Observatory, will naturally go to the most complete school. And if the teaching in such a school is thrown open to the public, so that on payment of fees non-matriculated students can attend, I am sure that a number of persons will be found ready to take advantage of it, and thus get initiated into the study of the grand science which entices so many to the private study of it. But the teaching must include the use of instruments as well as lectures upon the theory and practice. Indeed, an Observatory is just as essential to the teaching of Astronomy as the dissecting room is to surgery, the laboratory to physics, or the workshop to engineering.

In the present day Astronomy covers such a wide range of subjects, and requires the use of so many expensive instruments, that no Observatory, even the great National Observatories of Europe, attempts to take up all of them, and it is usual for Observatories to take up some *special subject*, and in this way the whole study is carried on by a number of independent Observatories. I think, therefore, the idea of having an Observatory covering all branches of Astronomy in Tasmania may be dismissed, and our attention confined to the requirements of one which will fulfil the testator's intention, and at the same time take up *one special branch* of the subject, and place Tasmania at once amongst those countries in which the Observatories are taking an effective part in promoting the progress of Astronomy; and, without doubt, the best way is to make its special feature *astronomical photography*. Such an Observatory, as I have already pointed out, is badly wanted in the Southern Hemisphere, and Hobart has special advantages of climate and position for the work.

We may then, I think, begin with these conditions, viz., that the Tasmanian Observatory should provide:—

(1.) All that is necessary for practical teaching in the School of Astronomy established within the University under the Leake bequest.

(2.) That its special work shall be Astronomical Photography.

(3.) That its name shall be the "Leake Observatory."

(4.) That its control and management shall vest in the Council of the University.

(*a*.) I have assumed that the Leake trustees are prepared to hand over to the University the Leake bequest of £10,000 for the establishment of a school for the practical teaching of Astronomy, provided that the Senate make such provision for it as will carry out the testator's wish as laid down in his will.

(*b*.) I have also assumed that the Government or the Senate of the University would provide a *site*, a piece of ground about 60 feet square, for the Observatory to stand upon.

(*c*.) Further, that the Government would keep public time as they do at present, and give time to the Leake Observatory, and permit the Leake Lecturer in Astronomy to use their transit instrument from time to time for teaching students in Astronomy.

If the arrangement assumed in (c) could not be made, there would still be sufficient funds out of the £3,000 *for instruments* for the purchase of a transit instrument. (See appendix A.)

The necessary equipment for an Observatory consists of a transit instrument, an equatorial with attached star camera, a good clock, photographic outfit, furniture, etc.

If it were proposed to devote the Observatory to the making of star catalogues, the greater part of the money would have to be spent upon the transit instrument; but since this is not proposed, a transit instrument of moderate cost will serve every purpose, and the greater part of the expenditure may properly be made upon a really fine equatorial with star camera attached,—such an instrument, in fact, as is used by all the 15 observatories taking part in the great work of photographing the heavens. This is, in the first place, an equatorial telescope of 10 inches aperture, and mounted on a stand of the most perfect kind that modern instrument makers can make, and so constructed that it carries with the telescope a star camera, with an object glass of 13 inches diameter. Such an instrument would be fit for any extra meridian work in addition to its use with the star camera. In fact, this instrument would be an exact counterpart of the instruments used in Greenwich, Paris, and other first-class Observatories for similar work, and would place the "Leake" Observatory in a position to do *first class work*, with the advantage of position over all other southern Observatories.

The only building required would be a round one, 26 feet in diameter, with revolving roof, and having cellar space sufficient for photographic work.

One first class regulator clock, together with some photographic and electrical apparatus and furniture, would complete the outfit, the cost of which I have estimated in appendix A.

I have been careful to add to the actual cost of the smaller items from 25 to 40 per cent. in each case, well knowing that contingencies arise which increase the cost.

The great item, the equatorial, I have set down at the price paid by Greenwich, the Cape, and Melbourne. In providing for the staff of the Observatory, I have ventured to suggest the appointment of a Demonstrator in Physics, in addition to the Lecturer, or rather to help the Lecturer in Mathematics, Physics, and Astronomy, because experience here shows that the professor or teacher in these subjects must have some help of the sort. If the expenditure is deemed too great, it could be reduced to, say, £100; for which salary I have no doubt an educated youth, or perhaps one of the students, would undertake the duty. The sum proposed, £250, would find an able Demonstrator, whose services in teaching science would materially add to the success of the school. If, however, it be decided not to have him at all, it would be better to increase the salary of the Photographer to £200, and get a man with wider experience, who should then be called *Observatory Assistant.* It will be observed that such a change, *i.e.*, omitting the Demonstrator and increasing the salary for the Observatory Assistant, will not alter the charges for salaries.

The sum of £50 a year set down for photographic plates, chemicals, etc., would, I have no doubt, cover the incidental expenses.

It would be a legitimate although perhaps small increase to the Observatory funds to hand over to it for current expenditure the fees paid by non-matriculated students of Astronomy.

It would be an easy matter to suggest various other instruments for the Observatory.

TO RECAPITULATE.

It is proposed that the Leake bequest of £10,000 be handed over to the University.

That the University establish a School of Astronomy and an Observatory, to be called the Leake Observatory.

That the Lecturer in Mathematics and Physics should also teach Astronomy, and have, under the governing body of the University, general control and direction of the Observatory, for which he should be paid from the Leake fund £100 per annum in addition to his salary from the University.

That an Observatory Assistant be appointed with salary of £200 per annum from the Leake fund.

That, if possible, the University should obtain permission from the Government to use their transit instrument for teaching purposes. If not, that a transit instrument be purchased at a cost of £110.

That a site for the Observatory be provided by the Government or the University.

That one round Observatory with revolving roof be built.

That a large equatorial, with star camera attached, be purchased at a cost not exceeding £1,800, together with necessary apparatus. (See page 4 and appendix A.)

That the Observatory work should be Photographic Astronomy, in connection with the photographic star chart now being made.

APPENDIX A.

SALARY.

Office.	University.	Leake Bequest	Total.	Remarks.
A Lecturer in Mathematics, Physics, and Astronomy.	£500	£100	£600	To give fifty lectures on Astronomy each year, and have general oversight and direction of the Observatory.
B Demonstrator in Physics and Astronomy.	*£200	£50	£250	To demonstrate in Physics and Astronomy and have general charge of the instruments.
C Photographer ...	*—	£150	£150	To do all photographic work and any other that may be necessary.
D Photographic Plates and Chemicals ...	—	£50	—	—

	COST OF INSTRUMENTS, ETC.	£	s.	d.
E	Equatorial telescope and star camera combined	1,800	0	0
F	Freight and charges	100	0	0
G	Observatory building	200	0	0
H	Clock	50	0	0
I	Batteries, furniture, etc.	50	0	0
J	To cover unforeseen expenses	200	0	0
	Total cost	£2,400	0	0
K	Reserve fund	600	0	0
E to K	Leake bequest for instruments	£3,000	0	0

Annual expenditure under A B C & D, amounting to £350, the interest on £7,000 from Leake Estate; in reference to B see page 30.

TRADE UNIONISM AS A FACTOR IN SOCIAL EVOLUTION.

By Alfred J. Taylor, F.L.S., F.R.G.S., E.

In any endeavour to trace the evolution of social life, we may safely assume as a starting point that the family is the natural foundation of all social relations.

Blood relationship would naturally, in its infancy, form the strongest tie between members of the human race. Then would come the ties of kinship: and these in turn would broaden out into the realisation of duties as between man and man—the observance of which would be necessary to give stability to a brotherhood based on the foundations of a *general* social relationship. As the conditions of society became more complex, various and conflicting interests would necessarily arise; and in time would become developed those well-defined separations of interests that characterise the social relations of the Nineteenth-Century Civilisation.

It is with one of these well-defined lines of development in social life that I have now to deal: and as all social and political changes are of slow growth, it must be remembered that I cannot possibly do more than touch upon some of the salient points in a subject so vast and interesting as that which we are about to discuss:—Trade Unionism as a Factor in Social Evolution.

In the first place I would remind my hearers, that as one of the necessary factors in the development of a higher civilisation a time was reached in the history of the human race when it became necessary for those having special regard for particular interests to combine for the promotion and protection of those interests.

Combination became necessary, for example, to counteract influences that were likely to become dominant to the injury of the common good: and thus we find that in the middle ages combinations known as "Craft Guilds" were formed in which masters and workmen united to protect the interests of certain trades.

These Craft Guilds, after long and obstinate struggles, succeeded in winning certain privileges and political powers that paved the way for the succeeding victories that have been won by the modern combinations known as Trade Unions.

The Craft Guilds, however, differed from the Trade Union in so far that, while under the former, masters and men combined for the common object of protecting their particular trades; the Union is designed to regulate the interests of Trade "exclusively from the workman's point of view. Instead of the Guild in which masters and men were as one, we have on the one hand the association of the employers, and on the other the unions of the workmen." (*Subjects of the Day*, page 106, August, 1890.)

At the time of the ancient Guild comparative equality prevailed. The master trained, personally, his own apprentices, who were in most cases inmates of his dwelling. The relationship between master and man was almost that of the family, "and their trade was a mystery not to be communicated to outsiders." But as the conditions of society changed, the masters, being the strongest, used their power "rather to advance their own individual interests than to serve the good of the whole trade," and this was the disintegrating factor that ultimately led to the breaking up of the Craft Guilds, and left labour without organisation of any kind whatever.

Taking advantage of their helpless condition, the dominant class, for the time being, influenced the Legislature to pass laws for the special government of the workers, to which we can only now look back with wonder and amazement.

Under the laws referred to, labour was enforced as a duty, and refusal to work was punished as a crime. "The rates of wages for which men should work were fixed by act of Parliament; and it was equally an offence for the workman to demand, or the employer to pay, more than the law specified. Combination of every kind was strictly prohibited, and any found uniting for the purpose of dealing with the conditions of labour were subjected to extremely severe penalties." (Ibid., page 107.)

Under Act 2 and 3, Edward VI., c. 15 (which is regarded as the starting point of Legislation against combinations), it was enacted "that if any artificers, labourers, etc., should conspire, covenant, or promise that they should not make nor do their work but at a certain rate, or should not work but at certain hours, they should forfeit, for the first offence, £10, or suffer twenty days imprisonment; for the second offence £20, or the pillory; for the third offence £40 or the pillory, and the loss of one ear," etc.

This law, we are told by the writer I have already quoted, "was in spirit but a type of all the Legislation affecting labour which prevailed right down to the end of the first quarter of the present century." "Indeed," he observes, "it is not too much to say, as Professor Rogers has done in his book on wages, that from the times of the Wars of the Roses up to the repeal of the combination laws, all legislation was 'a conspiracy concocted and carried out by parties interested in its success, entered into to cheat the English workman of his wages, to tie him to the soil, to deprive him of freedom, and to degrade him to irreparable poverty.' "

We all know the natural fruits of such legislation. Refused the privilege of stating their grievances openly and the right to combine to enforce, even in a legitimate manner, a recognition of their wrongs, men will work in secret and endeavour to accomplish by stealth, and in an illegal manner, the ends that should be attained constitutionally, if the truest interests of society are to be conserved.

It was so in the instance under consideration. When the workers found that they could do nothing lawfully to better their condition and relieve them from their enforced slavery, they formed secret combinations; for, as Howell has rightly affirmed, " Tyranny and oppression will always produce men who will not be deterred, by any consideration of danger, from combining to resist what they deem an injustice."

After the passing of the prohibitory laws I have referred to only the most zealous workers combined openly, " but," says Howell, " under the cloak of friendly societies many associations were formed . . . Secrecy was the child of suppression; the Legislature forged at once the chains of the workmen and the weapons for their deliverance."

When the law prohibited combination on the part of the workers, the journeymen tried to fix a list of prices. This the employers opposed on the ground that they alone had the right to fix the price of labour. The idea of arbitration in such matters was also opposed.

That the efforts of the workmen to combine were to some extent successful is sufficiently shown in the fact that at the commencement of the present century strikes were found to be common in almost every trade. Class interest and influence was consequently once more brought to bear, and in the year 1800 a statute was passed directed against all associations of workmen established for any of the purposes for which such societies where then in existence; for, as I have just mentioned, under the pretext of being friendly societies, associations had been formed having for their object the furthering of the interests of the workers as against the influence and power of the masters.

By the statute referred to (40 Geo. III., c. 106) all agreements between journeymen and workmen for obtaining an advance of wages for themselves or others, or for reducing the hours of work, or preventing the employment of hands, or in any way affecting any person carrying on any manufacture, was declared to be illegal. Power was given to one Justice of the Peace to convict summarily and impose imprisonment for two months upon any workmen making such agreements, or interfering in the other ways mentioned.

Under this law those who were bold enough to defy its provisions were made to suffer heavily; for the laws were put in force without mercy, and oftentimes in defiance of justice. As an instance, it may be mentioned in 1805 three linen-weavers were sent to Wakefield gaol for three months—one for the offence of carrying a letter to York requesting assistance from other workmen. The men were invariably punished very severely, but they invariably failed whenever they attempted in turn to prosecute the masters for combination, athough some of their cases were fully proved. I might cover pages in quoting instances in support of these statments, but that would only unnecessarily trespass upon the time I have at my disposal. Those who are curious in the matter I must refer to Howell's excellent account of the Conflicts of Capital and Labour, pp. 105-7.

"The history of these persecutions and contentions," says that writer, "and the consequent privations endured by the workmen, for the purpose of securing their independence, is a real record of heroism. In spite of oppression the most crushing; of legal enactments the most stringent; of punishments the most cruel for any infraction of these acts, the men continued to combine; they contested every inch of the ground, until, after a struggle of centuries, they were on the threshold of victory; partial, it is true, but still most important, viewed by the light of later facts. . . . . A few men in Parliament, with Joseph Hume at their head, had observed their struggles for industrial freedom, and in the year 1824 they moved for and obtained the appointment of a Select Committee of the House of Commons to consider the laws relating to workmen and artisans." The conditions under which the workers were struggling at this time may be judged from the statement of the same historian that "there are men still living who can recollect the time when they had to bury the books and records of their Society on the Town Moor of Bolton, in Lancashire, when oaths had to be resorted to, and were administered to for the purpose of securing mutual protection; when to ask for a rise of wages, or even to receive an advance, if offered, was a violation of the law," and when the exportation of machinery and the emigration of artisans was alike forbidden.

In due time Mr. Hume's committee brought up its report. Briefly summarised, it admitted that combinations of workmen had taken place in England, Ireland, and Scotland, and that at the time of taking evidence such combinations were in existence, attended with strikes—the object being to keep up wages, regulate the hours of working, and to impose restrictions upon the masters respecting apprentices or others whom they might think proper to employ; that serious breaches of the peace had resulted, attended with loss both to masters and workmen, and that the laws relating to combinations had not only not been efficient to prevent combinations, either of masters or of workmen, but on the contrary, in the opinion of many, had a tendency to produce mutual irritation and distrust.

The Committee expressed the opinion of its members that masters and workmen should be freed from the existing restrictions regarding rates of wages and hours of working, and be left at perfect liberty to make such arrangements as they might naturally think proper; also, that the Statute Laws interfering in these particulars should be repealed, as well as the common law under which a peaceable meeting of masters or workmen could be prosecuted as a conspiracy.

While suggesting these concessions, the committee recommended "That it is absolutely necessary, when repealing the Combination Laws, to enact such a law as may efficiently and by summary process punish either masters or workmen who by threat, intimidation, or acts of violence, should interfere with the perfect freedom which ought to be allowed to each party of employing his labour or capital in the manner he may deem most advantageous." (Howell.)

The result of the Select Committee's Report was the Act of 1824 (5 Geo. IV., c. 95).

This Act relieved workmen from all liability to punishment for engaging in peaceful combinations or strikes.

Strikes on a large scale immediately occurred in various parts of the country, and the Legislature was seized with a panic, which the manufacturers did their best to promote. Towards the end of the session the panic subsided, and "all parties," we are told, were contented with a reproduction of the Act last quoted "with some alteration in its shape, and in the language of some of its provisions." Statute 6 Geo. IV., c. 129, therefore took the place of Statute 5 Geo. IV., c. 95.

The employers realising that their former power to crush the workers and force them to accept the terms they might dictate was gone, were far from being satisfied; and in 1830 they succeeded in obtaining another enquiry bearing upon combinations and strikes. The report was fruitless, and was never officially published, but from the portions of it published in 1862 by Mr. Senior—and afterwards in his "Historical and Philosophical Essays" (1865)—it has been shown that it was adverse to the workmen.

Under Statute 6 Geo. IV., c. 129, while exempting from punishment persons meeting together to determine wages and hours of labour (which the persons actually present at the meeting might require or agree to give), the law defined all combinations or agreements affecting the wages or hours of work of persons *not present* at the meetings as conspiracies. Under the definition of conspiracies were also included attempts to control a master in the management of his business, and agreements not to work in company of any given person, or to persuade others to leave their employment, or not to engage themselves. For such offences the law-breakers were liable to fine and imprisonment.

At this period the growing activity of the Unions, and the frequent recurrence of strikes, intensified the anxiety and enmity of the employers.

In 1834 an incident occurred that brought into prominence the disabilities under which the workers were still labouring. "Six Dorchester labourers," says Howell (p. 116), "were convicted and sentenced to seven years' transportation, ostensibly for administering unlawful oaths, but really for the 'crime of combination.' This conviction was so manifestly unjust, and the sentence so outrageously cruel," he continues, "that some of the ablest, certainly the most independent, men of that day condemned *both*, in no measured terms; and they resolutely demanded the remission of the sentence on these six poor men, and their immediate liberation. An immense demonstration took place in the Copenhagen Fields, on Monday, March 21st, 1834, attended, it is said, by about 400,000 persons; and a procession between six and seven miles in length, consisting of nearly 50,000 workmen, proceeded to the official residence of Lord Melbourne for the purpose of presenting a petition with over 266,000 signatures, on behalf of those six convicted peasants. After a good deal of opposition on the part of the Whig Ministry of that day, backed as it was by the major portion of the manufacturing classes, and, after much delay, the men were 'pardoned,' and ordered to be liberated. But the whole proceeding in regard thereto," the writer goes on to say, "were shamefully cruel and even cowardly. The men had been hastened out of the country" (to New South Wales), "and, even when they were pardoned, some of them did not hear of their pardon until years afterwards, and these might never have heard of it until the expiration of their sentence, had it not been for the merest accident of one of them falling across an English newspaper in the colony."

This case, as might be expected, gave an impetus to the cause of Unionism. Stimulated by the successful meetings they had been able to organise, the workers were led to make an effort to establish a national federation of the whole of the trades. A weekly newspaper was started to assist the scheme, which for a time gave promise of success. When, however, the men who had been convicted were pardoned, the agitation cooled down. But the workers had got to realise their power. "Permanent work," says Howell, "had already begun to take the place of mere spasmodic effort; the several trades were busily employed in perfecting the machinery of their organisation, and thenceforth it is not difficult to trace their systematic operations, and discover the permeating influence of their associative strength and power."

The history of Unionism from this stage for some years afterwards is a record of strikes, prosecutions, and protests, not against the law, but against the way in which it was being administered.

The prosecutions and convictions resulted in the Unions increasing in number; and, on March 25, 1845, a Society was established, under the title of the National Association of United Trades, which became the the centre of a great movement, and gave birth to a newspaper called the *Labour League*. It proposed to raise a sum of £50,000 to provide a fund for the support of workers thrown out of work by labour disputes. It bore fruit in the consolidation of trade associations, and the better understanding of the aims and objects of the Unions.

In 1856 a Select Committee was appointed to enquire into matters connected with masters and operatives; and in 1860 another committee was appointed for a similar object. These inquiries served the purpose of throwing light upon the questions at issue betweeen the employers and the workmen.

As I have already mentioned the feeling of the workmen had not been so much against the law as against its administration, but the Builders' Strike and lock-out in London in the year 1859—the excitement attending which created universal interest for many months—brought about a crisis that led to an organised effort and demand for the amendment of the law itself. The Press took the side of the employers, and denouncing the Unions as Secret Societies, "whose power was sustained only by terrorism," demanded that they should be stamped out as an incurable and detestable evil. The Unionists replied by challenging investigation. In the year 1866 it was shown as the result of enquiry by a Select Committee, that the average number of convictions, under the existing laws in England and Scotland alone exceeded 11,000 cases annually. The enquiry led to the passing of the Master and Servants' Act, 1867.

In the latter year outrages said to have been committed in Sheffield, Nottingham, and Manchester, led to the appointment of a Royal Commission, with power to enquire into the organisation, rules, operations, and conduct of trade societies.

"The investigation," Howell tells us, "was searching and complete. The result was embodied in 16 volumes of reports; the ordeal was a severe one, but," he adds, "the Unions as a whole came out of it *without a stain.*"

Trade Unionism, and the cause it represented, had won a great and glorious victory. This was demonstrated in the results of the enquiry. Instead of Legislation to suppress "the incurable and detestable evil," a Temporary Act, protecting the funds of the Unions, was passed in the year 1869, and two years afterwards was passed a Trade Union Act, which sanctioned their objects and legalised their action.

What a shout of victory must have gone up when the workers realised that the law might be appealed to in the future for their protection, and might no longer be used as an instrument of persecution and revenge in the hands of their masters!

And it was in their onward march from this point that we have had a splendid illustration of the truth of Mr. Gladstone's utterance when he declared that we may always trust the People.

" After the passing of the Criminal Law Amendment Act, 1871," writes Howell (p. 126)—and let the record ever remain to the honour and glory of the Trade Unions—" the agitation for the total repeal of all the penal laws affecting labour became more and more intensified and persistent;" but " the action for securing this end was constitutional and methodical; the public mind was educated by meetings, lectures, publications, annual congresses, deputations to ministers, and interviews with members of Parliament, and by debates, bills, and petitions, until at last a Conservative Government in 1875, after a slight show of resistance, with the excuse and help afforded by the report of another Royal Commission, granted the workmen's demand."

So much for the history of Trade Unions in Great Britain up to the time when the National Conscience found expression in the voice and action of the Legislature, and set the workmen free.

During the past 27 years the British workmen have shown themselves worthy of the confidence reposed in them; and by their conduct they have justified before the whole world the action of the Nation's Legislature in granting them the freedom they now enjoy.

My notes on the history of Trade Unions would hardly be complete without some reference to the labour struggles in the United States, and on the Continent. I have dealt most fully with the evolution of Unionism in Great Britain, because there we find the best illustration we can obtain of Unionism as a factor in Social Evolution, for there we have a land

> "Where freedom broadens slowly down
> From precedent to precedent;
> Where faction seldom gathers head,
> But by degrees to fulness wrought
> The strength of some diffusive thought
> Hath time and space to work and spread."

The era of the Civil War—we are told by Dr. Ely, in his History of the Labour Movement in America—brought into prominence, with other matters of importance, a vast number of labour problems, due to fluctuations of the currency, to rapid changes from prosperity to adversity, and also to the sudden and marvellous accumulation of wealth in the hands of successful business men and lucky adventurers. "Never before," he writes, "were there such sharp contrasts in the country between riches and poverty. . . . . Two other especially weighty circumstances must not fail to be mentioned. First, the concentration of the labouring classes in large establishments in great industrial centres had continued without interruption; second, during the war, native labour had in many quarters been replaced by foreign labour, and race antagonism added intensity to the natural struggle between employer and employed."

To these causes we may trace the organisation of labour in America.

"Most trades," writes Mr. Washington Gladden, in his article on "Social Problems in the United States" (*Subjects of the Day*, Aug., 1890), "are now organised; there are also trades assemblies in which some degree of co-operation between the trades is secured, and one National Society, the Knights of Labour, has been formed, whose ambition it is to gather into its ranks all classes of labourers, organised and unorganised. But," he continues, "if any compact union of the labouring classes is to be secured, it is likely to take the form of a federation of Trades' Unions, rather than that of one comprehensive labour organisation into whose local unions labourers of all classes shall be promiscuously gathered."

I need not follow the growth of the labour movements in America much further. Suffice it to say, that for the six years ending 1866, strikes and lock-outs occurred, and battles were fought in the interests of labour involving a cost to the employees amounting in round numbers to twelve millions sterling.

"One result of the labour war of 1886," says the writer last quoted, "was the introduction into a considerable number of establishments of the principle of participation in profits. . . . Since that date the movement has been steadily gaining ground; the success of some of the experiments has been notable, and there is a fair prospect that the system of participation will gain a firm footing in our industrial Society. That it is logically the next stage in the evolution of labour seems obvious."

On the Continent, the workers have to win their right to combine for the protection of their mutual interest. They are as yet only experiencing the throes of the political birth-pang that will ultimately give them the liberty they are aiming at.

I turn now to the second portion of my paper in which I wish to deal briefly with the tendency of Trade Unions.

When it is remembered that "associative effort"—taking shape in Trade Unionism—has been the "natural evolution of generations of increasing political freedom," and that each form of industrial association is that most suitable to the conditions under which it originates and lives, I think it will also be admitted that the present potentialities of Unionism need give us no alarm for the future.

I hold with Mr. William Clark—one of the contributors to the interesting "Fabian Essays," (p. 62), "that there *has* been, and *is proceeding*, an Economic Evolution, practically independent of our individual desires or prejudices;" and holding this as an article of my political faith, I do not contemplate the future of Unionism with fear or misgiving.

Unionism, like the individual, has to spell out its way in syllables of painful experience, but the fact that it has sometimes seemed to blunder and fail has no more been an indication of weakness or want of vital strength than is the falling back of a ripple on the sandy shores an indication that the waters are receding from their work of drawing down the "dust of Continents to be."

"No doubt vast eddies in the flood,
Of onward time shall yet be made,"

but are the eddies any indication that the waters are not passing onward? Nay! do not the eddies create the very force necessary to carry them forward?

Let us not, then, judge Unionism by the apparent mistakes that have been made, but rather by the sun-lit milestones that have marked its progress.

On pages 427-9 of his history, Howell gives a list of nearly 60 important Acts which were more or less the outcome of the combined action of the Trade Unions during the years 1869 to 1889; and even this list, it is admitted, gives but a bare record of the direct results of the action of the Unions and Congresses, and, more recently, of labour representation in the National Parliament, where the voice of Unionism is now listened to with respect, and its influence made manifest. As Howell has pointed out, however, "it is not so much in specific performances that the record of Trade Unions is seen to greatest advantage. It is rather," he says, "in those unrecorded fields of labour which constitute the everyday life-work of the Unions that they display their power, wield their influence, and achieve their more permanent successes. The improved condition of the working classes to day is largely due to their efforts. The improvement has been slow—terribly slow; and it is not so apparent to the younger generation as to those whose age and experience takes them back to the "forties" and "fifties" of the present century. The progress, nevertheless, has been real and substantial in material advantages—wages and hours of labour; in social position, by the recognition of industrial rights; in political status, by enfranchisement and election to the highest posts open to popular election; in constitutional rights and judicial obligation by the repeal of repressive and disabling laws, and by the enactment of more just and equitable enabling laws . . . and even in the administration of justice the position of workmen has improved enormously." This writer strongly emphasises a fact that he declares has hitherto been lost sight of by economical writers, and that is, "the higher duration of life attained by the members of the Unions in recent, compared with former, years." He gives striking statistics in support of this assertion, and points to the important consideration that this longer duration of life speaks volumes as to the present improved conditions of life and labour—that the homes and circumstances of the people must be better, for the wives share in the longer duration of life, and that the improved conditions of the heads of the family cannot fail to exercise a beneficial influence upon its younger branches.

Above all, it has been the tendency of Unionism to bring more prominently under notice the absolute necessity that exists for a wiser allocation of labour, if misery is to be banished from the ranks of the working classes. This is the problem towards which associative effort must turn its almost undivided attention in the immediate future. Almost without consciousness of the fact the Trade Unions have been working out the answer to the riddle, working it out, it may be, through much travail and suffering, but with a growing demonstration of the fact that "the end will crown the work."

What are the avowed objects of Trade Unions? I do not ask upon what grounds we may justify their existence, for their existence is explained in the fact of their adaptibility to the economic conditions under which we live. Trade Unionism takes it place as a natural and necessary factor in the evolution of social life, for as Jevons nicely puts it in his little work on "The State in relation to Labour" (p. 88), "Common trade interest is one of the strongest bonds of society, and, judged by the light of history, is likely always to be a considerable factor in social affairs."

"In their essence," writes Howell, "Trade Unions are voluntary associations of workmen for mutual protection and assistance in securing generally the most favourable conditions of Labour. This is their primary and fundamental object, and includes all efforts to raise wages or prevent a reduction in wages; to diminish the hours of labour, or resist attempts to increase the working hours; and to regulate all matters pertaining to matters of employment or discharge, and modes of working . . . The sphere of their action extends to almost every detail connected with the labour of the workman and the well-being of his everyday life."

Such aims and objects as these must necessarily have a tendency for good, and if in striving to give effect to the ideals they "stretch lame hands of faith to reach" the Trade Unions sometimes get caught in the eddies of the flow-tide of Social Evolution, the experience is wholesome, and must be recognised as an essential factor in their progress. In this fact lies our hope for the future. Each mistaken effort of misused strength in the past has taught them lessons of wisdom that will certainly be taken advantage of, and turned to good account in the future. Every conflict that now takes place between Capital and Labour, and all the experience of the troublous past, goes to demonstrate beyond any room for doubt that the objects and aims of Trade Unions must be attained peaceably, or not at all; that their work must be carried out upon constitutional lines, and must find a response in the National Conscience if it is to bear the fruit they hope to pluck.

In the fact that the Unions must, as a matter of experience, get to recognise these truths, lies our guarantee of the benign influence that associative trade effort is likely to exercise in the future.

It will be remembered that in my opening remarks I referred to the broadening of the ties of kinship into a realisation of the duties between man and man that finds expression in a brotherhood based on the foundations of social duties and relationship.

In the gradual evolution of the highest civilisation there must necessarily be different phases of social relationship. The phase we have now entered upon is being largely moulded and shaped by the influence of Trade Unionism, and I do not think there is anything to regret in our forced admission of this fact. For, if the human race is progressing, and not retrograding, then, surely, the recognition of the fact that Trade Unions have become important factors in the development of a higher civilisation is sufficient demonstration in itself that the tendency of Trade Unionism is for good and not for evil.

The more immediate tendency of associative effort on the part of the working classes appears to my mind to lie in the direction of a fairer apportionment of the world's wealth, and a wider recognition of equality and brotherhood than has yet been realised in the world's history.

The present strife between Capital and Labour cannot continue for ever. Each conflict has but served the purpose of bringing the contending parties closer together, and the time cannot be far distant when they shall stand face to face, and agree to live and work together in unity of purpose for a mutual good.

That is what I see in the immediate future as likely to result from the victories of Trade Unionism, in the past, and its influence at the present time—an Industrial Partnership, in which, social distinctions being set aside, the skilled workman will work hand to hand with the man of capital, and each will share the just profit of his enterprise and skill.

And, far away beyond this, I see the development of a social life in which associative effort will have played a not unimportant part, the ideal Socialism of One

"Who wrought
With human hands the Creed of Creeds
In loveliness of perfect deeds."

NOTES ON TASMANIAN CRUSTACEA, WITH DESCRIPTIONS OF NEW SPECIES.

By Geo. M. Thomson, F.L.S.
(Corresponding Member Royal Society of Tasmania).

When in Tasmania in January of this year I collected a few specimens of Crustacea in the neighbourhood of Hobart, and also obtained others from Messrs. A. Simson, of Launceston, and L. Rodway, of Hobart. Since my return to New Zealand several specimens have been forwarded to me by Mr. C. Chilton, who obtained them from Mr. R. M. Laing, and a number of others have been received from Mr. Morton.

As far as I am aware, no one in Tasmania has devoted special attention to the Crustacea, though a few species have been described in foreign publications from material gathered in the colony. In the "Catalogue of Australian Stalk and Sessile-eyed Crustacea," by Prof. Haswell, of Sydney, which was published in 1882 by the Trustees of the Australian Museum, 42 species are recorded (and 41 described) from Tasmania. Seven more are described as occurring in Bass Straits, some of which are no doubt to be found on the Tasmanian shores. In the various reports of the collections made by the "Challenger" expedition several additional species are also recorded from Bass Straits, to which the same remark applies.

Only *four* of the previously described forms are fresh-water species, namely: *Astacopsis franklinii* and *A. tasmanicus*, *Engæus fossor* and *E. cunicularius*, all fresh-water crayfishes. The latter genus is found in Gippsland as well as in Tasmania. Judging by past experience as to the limits of variation among fresh-water crayfishes, it will probably be found on further examination that the two Tasmanian species of *Engæus* are not entitled to rank separately; Erickson's descriptions are not very satisfactory.

The collection examined by me includes 22 species. Of these only 5 have been recorded in the Catalogue of the Australian Crustacea; 10 have been already described from other parts of the world, but are now recorded for the first time from Tasmania, while 7 are quite new and are described here for the first time. In an appendix I add a species described by Budde-Lund. These additions bring the total number of species now known to occur in Tasmania to 58. It is manifest that this represents only a fraction of the forms which must occur in the colony.

The most interesting of my finds is certainly the Schizopod shrimp (*Anaspis*) found in pools at the top of Mt. Wellington. How an animal of such conspicuous size should have hitherto escaped the observation of collectors, occurring as it does in a locality which residents, as well as visitors, to Hobart visit in numbers every season, is only another proof of the small amount of attention which has hitherto been paid to this section of the Tasmanian fauna.

This animal is, I think, one of the most remarkable Crustaceans found of late years. How and when its ancestors reached its present habitat is one of those questions which we have no present means even of guessing at. Its nearest allies—and even they are very distantly related—appear to be among the Euphausiidæ, a deep sea group of Schizopods. But the whole structure of the animal has become so profoundly modified from that of all known Thoracostraca, that I think we must assign it a very high antiquity. To take only two of its most prominent characteristics, it has completely lost the shield or carapace so distinctive of all other animals of the order Thoracostraca, and no doubt in association with this its gills have become plate-like and project externally along the sides of the thorax. The loss of the carapace is the feature which has suggested the name *Anaspis* to me. In respect to this feature, and also in its gills, the animal resembles an Amphipod, the resemblance being, however, purely external and having no importance. It is this feature again which suggests the great antiquity of the form, for among all the Thoracostraca the carapace appears at an extremely early stage of the development of the individual, and is present in all the sub-orders. In the Euphausiidæ the young animal is hatched as a Nauplius with a large well-developed carapace. At what stage of its development *Anaspis* loses its carapace, or has already in the course of its evolutionary history lost it, is a question which I am unable at present to solve; meanwhile I think it advisable to create a new family Anaspidæ (Tribe Schizopoda) for its reception.

The occurrence of fresh-water Amphipoda of the genus *Niphargus* is another point of great interest. *N. montanus* seems common enough in the smaller pools and among the swampy ground on the top of Mt. Wellington. I did not find it in the large pools with *Anaspis;* the latter would, perhaps, exterminate it in such open localities. I collected *N. mortoni* originally in a small rill at an elevation of only 200 or 300 feet above high-water mark, at Franklin on the Huon, and was at first under the impression that it might prove only a transitional form between a littoral and a fresh-water species. But it appears to be abundant in the streams coming down the seaward side of Mt. Wellington at elevations of 2000 feet and more. It is just questionable whether my specimens are strictly referable to the genus *Niphargus*, occurring, as the latter does, only in the subterranean waters of Europe. The genus is probably of considerable antiquity, for it has undergone a good deal of modification. *N. montanus* is also probably of very considerable age as a species, for not only does it occur at a much greater elevation than *N. mortoni*, but it has also undergone greater modification of structure. It would aid us, perhaps, in the elucidation of this problem if all the fauna of the pools on Mt. Wellington were to be examined. The researches conducted by Mr. Chilton and myself on the New Zealand Crustacea have brought to light some interesting facts in this connection. For example, of fresh-water Amphipoda and Isopoda there are eight known species in New Zealand, three of which occur in streams, etc., and five are subterranean—of the former, *Idotea lacustris* ranges from brackish waters, just above tide-marks, to a height of 1200 ft. The species belongs to a genus having several marine representatives in the New Zealand, and is apparently identical with a form found in the Straits of Magellan. Our species therefore is apparently in course of development into a truly fresh-water form. One species of *Pherusa* (marine) occurs in the shallow coastal waters, another, very different, has only hitherto been found at elevations of 2000 feet, quite 100 miles from the sea. One species of *Calliopius* is marine (littoral), one occurs in fresh-water streams, and a third in the underground waters of the South Island. On the other hand, *Gammarus fragilis, Crangonyx compactus, Phreatoicus typicus*, and *Cruregens fontanus* are all species occurring only in subterranean waters, and of which no related marine species have been found. They have very probably been long isolated, especially the two last, and have undergone a very considerable amount of modification. It may ultimately be possible to trace the developmental relations of several of these fresh-water forms from allied marine forms now occurring in the adjacent seas, and this is being gradually done in New Zealand. In the case of Tasmania however, so little is yet known of the Crustacean fauna, that any speculations as to the origin of the fresh-water forms are premature. In light of the finds recorded by me, however, naturalists will wait with some impatience for further researches on the fresh-water fauna of Tasmania.

The terrestrial Crustacea are of very great interest as bearing on the question of geographical distribution. *Talitrus sylvaticus* is an Amphipod common to Tasmania and the eastern parts of Australia. It is the representative in damp woods of the New Zealand *Orchestia sylvicola*. How widely these species differ, or whether they are not indeed too closely allied to be separated even specifically, is still an undetermined point, the whole relationships of the Orchestidæ requiring to be carefully worked up. *Oniscus punctatus*, the common wood-louse of the bush, found along with the last species under dead leaves, etc., is also common in New Zealand, where it is associated with *Orchestia sylvicola*. *Porcellio graniger*, another common wood-louse of New Zealand, and which has also been recorded from Tasmania, is not, as a rule, found in the damp bush in the eastern colony. It affects drier situations, and is the species which frequents houses and gardens. It may prove to be a cosmopolitan species. It is certainly likely to be widely spread by artificial means, as New Zealand and Tasmanian ferns and other bush plants, especially when packed for export in nurserymen's establishments, are almost certain to contain specimens. The question requires examination. Gustave Budde-Lund (Crust. Isop. Terrestria) thinks that probably this species does not differ from *P. lævis*, a form found in nearly every country of the world.

I have, in this paper, described the new species of Amphipoda at—what may appear to some to be—undue length. But in face of the confusion which has arisen in the past from imperfect descriptions of species of this group, I think it better to err in the direction of minute treatment than to leave in doubt the characters of the forms which are being described.

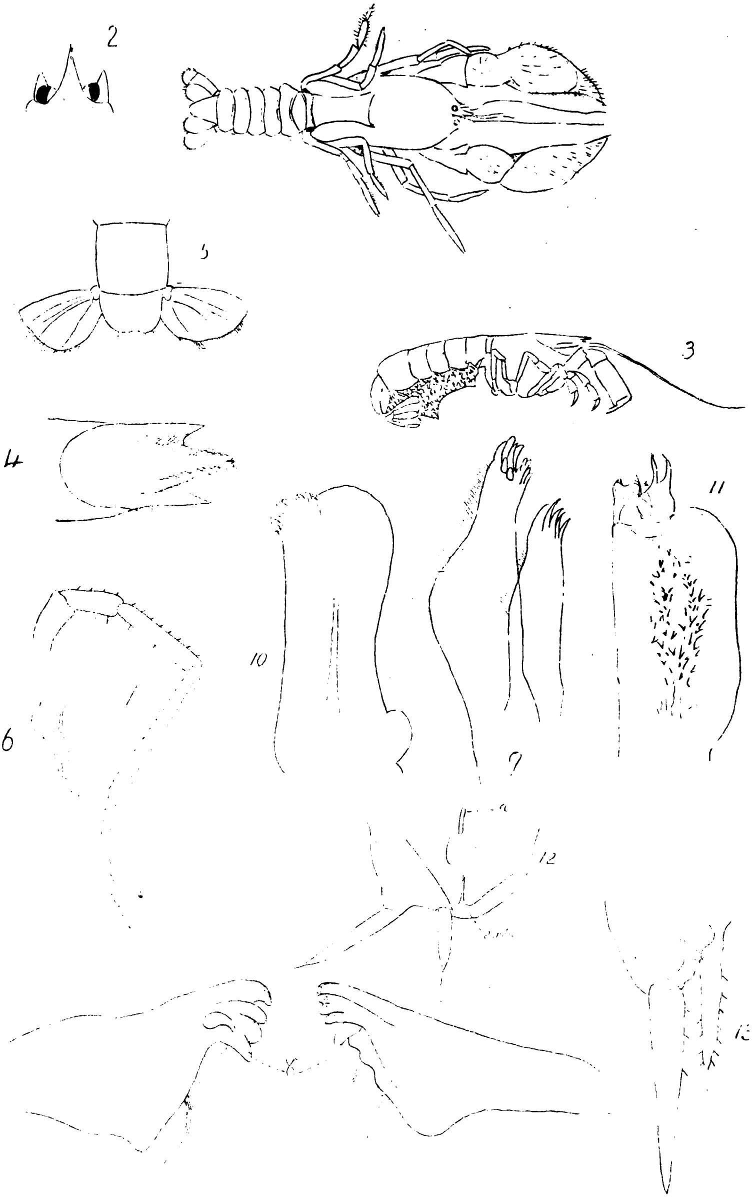
The following species are described here for the first time:—

Gebia simsoni.
Anaspis tasmaniæ
Rocinela spongicola.
Lysianax stebbingi.
Atyloides tasmaniæ.
Niphargus mortoni.
——— montanus.

The following species, already described, are here added to the fauna of Tasmania:—

Pinnixa faba, Dana (Australia, etc.)
Petrolisthes elongatus, Heller (Australia & New Zealand).
Leander intermedius, Stimpson (Australia).
Oniscus punctatus, mihi (New Zealand).
Ligia australiensis, Dana (New South Wales).
Actœcia euchroa, Dana (New Zealand).
Sphæroma gigas, Leach (Kerguelen Island, Australia, New Zealand, Auckland Islands, Falkland Islands, Tierra-del-Fuego).
Iais pubescens, Dana (Kerguelen Island, New Zealand, and Tierra-del-Fuego).

Pl. I



Hyale rupicola, Haswell New South Wales).
Mæra fasciculata, mihi (New Zealand).

Tribe *Brachyura.*

Fam. *Pinnotheridæ.*

1. *Pinnixa faba.* Dana.

I picked up a single specimen (female) of this small crab on the beach near Hobart, and Mr. Morton has sent me a number collected by himself from mussels, also all females. I follow Prof. Haswell in assigning my specimens to this species, though it seems questionable to me whether all the species of *Pinnixa* and *Pinnotheres* are not referable to one and the same slightly varying form. This species appears to be common enough about Hobart, though it has not previously been recorded from Tasmania.

Tribe *Anomoura.*

Sub-tribe *Porcellanidea.*

2. *Petrolisthes elongatus.* M. Edw.

Specimens of this shore crab, so common on the coasts of New Zealand, were found under stones between tide-marks on the beaches in the neighbourhood of Hobart. It has not previously been recorded from Tasmania.

Tribe *Macroura.*

Fam. *Callianassidæ.*

3. *Gebia simsoni.* Nov. sp. (Pl. I., figs. 3—5.)

Front three-lobed, the carapace being produced in the median line into a blunt rostrum, and the margins also produced forwards into acute points. The anterior portion of these margins and of the rostrum are crenately toothed and somewhat hairy. External antennæ three-fourths as long as body, internal pair having the peduncle reaching as far as the peduncle of the external pair; both flagella extremely short. First pair of legs very stout; mesos broad and flattened, with about four small teeth on its lower distal margin, and one on its upper margin near the end; carpus with one strong tooth on the lower inner margin; propodos elongate sub-quadrate, the lower margin produced into a long stout tooth; palm transverse; dactylos nearly straight, acute, very hairy, and twice as long as palm.

In the general form of the front of the carapace (fig. 4), this species resembles *G. spinifrons* (Haswell), but is distinguished by the almost total absence of spines by the form of the hand in the first pair of legs, and by the absence of distinct epimeral thickenings on the sides of the abdominal segments. The legs of the second to the fifth pairs are destitute of spines, but have the carpus, propodos, and especially the dactylos somewhat thickly furnished with hairs. The telson (fig. 5) is short, very broadly rounded, and is thinly membranous in texture. The external plate of the last pair of pleopoda broadens posteriorly, and is strengthened by two stout nearly parallel median ridges in addition to its marginal thickening; the internal plate is obliquely fan-shaped, and is strengthened by one median ridge. Length 44 mm. (1¾ inch).

A single specimen was handed to me by Mr. A. Simson (after whom the species is named), who obtained it on the East Coast. It is a female, having the whole under surface of the abdomen covered with ova.

Fam. *Astacidæ.*

4. *Astacopsis franklinii.* Gray.

A few small specimens of this common freshwater Crayfish, obtained at Zeehan (?), were handed me by Mr. Simson. Gray's short description reproduced in the Australian Museum Catalogue (p. 176) is substantially accurate. In none of my specimens, however, were "the sides of the second abdominal rings spinose." On all of them examples of the parasitic *Temnocephalus qudricornis* (Haswell) were found.

5. *Engæus cunicularius.* Erichson (Pl. I., figs. 1 and 2).

Specimens of this small freshwater crayfish, collected at Zeehan (?), were handed me by Mr. A. Simson. The name is wrongly printed *E. cunicularis* in the Australian Mus. Cat. It differs from *E. fossor,* according to Erichson (Archiv fur Naturg., 1846, p. 102) not only in the absence of a toothed border on the lower side of the hand, but also in its more rounded carapace, its broader rostrum, larger eyes, sharp-pointed antennary scale, and in the greater breadth of the posterior part of the abdomen. In the absence of examples of *E. fossor,* I cannot compare the two forms, but the characters seem hardly good enough to found a specific distinction upon.

My largest specimen was 1¾ inches in length from the point of the rostrum to the extremity of the caudle swimmerets; the chelæ were about 1½ inches long. In the figure (fig. 1) the relative narrowness of the abdominal segments as compared to the carapace is not brought out. The carapace is deep relatively to its breadth, and in general appearance the whole body is much compressed, The carapace is produced in front into a minute sharp rostrum (fig. 2), reaching slightly beyond the eye-sockets, and on the upper part of it are two minutely setose ridges which converge towards it extremity. The eye-peduncles are very short, and the acutely-pointed scales of the outer antennæ hardly reach beyond them. The whole body is nearly smooth, and there are only a few small hairs on tho outer joints of the legs.

Fam. *Palæmonidæ.*

6. *Leander intermedius.* Stimpson.

A single specimen of this prawn,—a female carrying an immense number of ova beneath the abdomen,—was obtained on the East Coast by Mr. A. Simson. The species has not been recorded from Tasmania before.

Tribe *Schizopoda.*

Fam. *Anaspidæ,* fam. nov.

Carapace wanting; the cephalon and all the segments of the body distinct. Maxillipeds and succeeding seven pairs of legs nearly uniform in structure, adapted for walking. Branchiæ lamellar, all external. No egg-pouch. Pleopoda with well-developed natatory exopodites; endopodites of first and second abdominal segments, specially modified in the males as copulatory appendages. Uropoda, normal. Development?

Genus *Anaspis,* gen. nov.

Integument thin and flexible. Whole body divided into fifteen distinct subequal segments, viz., cephalon, eight thoracic, and six abdominal. Eyes well developed. First antennæ, with three-jointed peduncle and two flagella. Second antennæ, with well developed scale on the second joint. Mandibles with three-jointed palpi. First maxillæ two-branched; second pair four-branched. Maxillipeds pediform, with two rudimentary branchiæ projecting externally from the coxa; exopodite small and rudimentary. Legs generally uniform in structure, seven-jointed, each furnished with a claw-like dactylos. The coxa of each leg (except those of the last pair) bear two external lamellar branchiæ which project forward, and the basos bears a well-developed natatory exopodite. Genital opening of the female on the sternum in front of the last pair of thoracic legs. Telson short, rounded. Uropoda with the plates subequal; inner with a slight longitudinal median ridge; outer, with an imperfect transverse articulation near the middle.

7. *Anaspis tasmaniæ,* sp. nov.

The characters of this remarkable and interesting shrimp—the only truly freshwater schizopod I think yet found—are briefly expressed in the diagnosis of the genus. A few details may be added here, but I propose elsewhere to describe the animal more fully, and to discuss its affinities.

The cephalon is hardly larger than any of the body segments, and is produced in a very short acute rostrum between the bases of the antennæ; its sides are sub-equal in depth to the succeeding segments. The first thoracic segment alone has its sides divided by a very distinct and somewhat oblique line into a broad epimeron; none of the other segments bear any traces of epimera. The lateral margins of all the thoracic segments but the last are more or less covered by the plate-like branchiae of their respective segments, which are all external to the body and project forwards. The abdominal segments are somewhat longer than the thoracic; their margins are smooth, except the two last, which are slightly fringed with short tooth-like spines or setæ.

The cephalic segment carries the ophthalmites, two pairs of antennæ, the mandibles, and two pairs of maxillæ. The first thoracic segment carries the first pair of walking legs, which are the modified maxillipeds. Each of the succeeding segments bears a pair of appendages, those of the thorax acting partly as walking legs and partly as natatory organs, and those of the abdomen as natatory organs. The telson is bluntly triangular in form, slightly ridged down the median line and thickened along its outer margins; the posterior rounded margin is furnished with a comb-like row of short spines.

The eye-peduncles are short, one-jointed, and directed obliquely outwards. The antennæ of the first pair have a three-jointed peduncle, the joints of which are broad and rather flattened. The last joint bears two flagella, the outer of which is composed of a great number of articulations—usually from 75 to 100—and is from two-thirds to three-fourths the length of the whole animal; the inner is less than one-fourth the length of the animal, and is divided into from 20 to 25 articulations only. The *second antennæ* have a four-jointed peduncle, with a long multi-articulate (50-60 joints) flagellum, the first joint of which is probably, however, to be reckoned as the fifth of the peduncle. The moveable plate at the end of the second joint is oval, and has a smooth margin fringed with long plumose setæ. The flagellum is about two-thirds as long as the body of the animal.

The *mandibles* are strongly developed and are placed so as to close the mouth opening with their exposed part. The cutting edge is furnished with a double row of strongly indurated teeth, and at right angles to it stands the large oval grinding tubercle. The *first maxillæ* are two-branched only, the outer branch ending in a double row of strong spines which are pectinately toothed on the inner side, and the inner branch, which is both smaller and more rounded, being fringed with short plumose setæ. The *second maxillæ* are four-branched, each branch being one-jointed. These two pairs of organs appear to be purely masticatory in their function and to differ from those of other Schizopods, not only in the number of their articulations, but also in the total absence of any external appendages. The *maxillipeds* are similar in general form to the succeeding pairs of legs. They are very distinctly seven-jointed, and bear on the inner side of the coxal joint two small lamellar organs fringed with setæ, and which appear to act as masticatory lobes subsidisary to the maxillæ. These resemble in a more highly developed form the masticatory lobe found on the corresponding joint on the maxilliped of most species of the Euphausiidæ. On the outer side of the coxa are two small lamellar branchiæ, while the basos bears a short slender one-jointed exopodite which just shows at its extremity traces of the articulation which characterises the same organ in the succeeding appendages. The dactylos of this limb (and of nearly all the succeeding pairs) ends in two or three powerful hooked claws which are almost hidden among setæ.

The other seven pairs of *walking legs* increase in length up to the fourth, which is the longest, and then gradually decrease in length and robustness to the last. The branchiæ, which greatly resembles the same organs among ordinary amphipod crustaceans, undergo a somewhat similar progression and diminution in size, but are quite wanting on the last pair. The exopodites or natatory branches increase in size relatively to the limbs which bear them from the first up to the sixth pair, in the seventh they are reduced to small branchia-like processes, quite destitute of segmentation, in the eighth they are quite wanting.

The five pairs of *pleopoda* are all similar in form in the females. Each consists of a basal joint carrying a large natatory exopodite near its outer angle, and a small lamellar endopodite, like a rudimentary gill, on its inner angle. In the males the endopodite of the first pair is developed into a lamelliform plate, projecting inwards and apparently furnished with a duct, while the corresponding limits of the second pair are produced into two scoop-like processes, with their hollow faces meeting in the median line. I have not discovered the use of these organs. The sixth pair or *uropoda* are developed into a large tail-fin as in most Schizopods, but owing to the shortness of the telson this is formed of four (not five) plates. The plates are sub-equal in length, narrow-oblong in form, and are fringed with long comb-like setæ. The outer plates are ridged on their outer proximal margins, and are partly divided by a transverse ridge defined by a row of short spines. The telson is short, rounded and toothed round the end.

Large specimens are about $1\frac{1}{2}$ inches in length, the average length being about one inch.

The colour is grayish, becoming brown in spirit specimens.

I discovered these remarkable shrimps in a pool near the top of Mount Wellington, that is, at an elevation of over 4,C00 feet. The pool had deep crevices among the boulders, and in these dark recesses large specimens seemed to be abundant, but they were shy and difficult to capture. Crumbs, etc., dropped on to the sloping rock bottom of the pool attracted them however, and I was able to secure several specimens, apparently all females. This was in January. At my request, however, Mr. L. Rodway visited the spot on the 24th May. The ground was then covered with snow and the pools all frozen over. After breaking the ice, he put in a small net baited like a crayfish net, and as the result of several hours' patient waiting in an extremely cold situation he succeeded in securing a large series of specimens of both sexes and of considerable range of size. I wish to take this opportunity of thanking Mr. Rodway for his kindness to me in carrying out my request with so much enthusiasm.

I believe this form to be the most interesting Crustacean which has been discovered for very many years.

Tribe *Isopoda.*

Fam. *Oniscidæ.*

Sub-Fam. *Oniscinæ.*

8. *Oniscus punctatus*, mihi (Pl. I. figs. 6-13).

This terrestrial Isopod, so common among fallen leaves, etc., in the New Zealand bush, seems to be equally common in similar situations in Tasmania. I obtained some specimens along with *Talitrus sylvaticus* on the slopes of Mount Wellington, and received a number also from Mr. Morton, collected from the same locality. My original description in the Transactions of the New Zealand Institute, vol. xi., is very meagre, and the figure most unsatisfactory; I therefore take this opportunity of amplifying both.

The length of the body is more than twice its breadth, the lateral margins of the segments are rounded, and—except the last—hardly produced backwards. The thoracic segments are unequal in length, the first being the longest, then diminishing to the fifth, which is the smallest, the two last being somewhat longer. The abdomen is about two-thirds as broad as the thorax, and rather more than one-third as long.

The head is short and much narrower and shorter than the succeeding segment, with which it articulates closely; the eyes are small and are placed quite at the sides of the head. Seen from the front the epistome is slightly arched. The first antennæ (fig. 6) are very minute and three-jointed, the third joint being minutely setose at the extremity. The second antennæ (fig. 7) are about as long as the head and first three body segments, they are strongly geniculate; the three-jointed flaggelum is sub-equal in length to the last joint of the peduncle. The mandibles (fig. 8) end in four chitinised brown curved teeth, in addition there stands on the inner side of these a single pale-coloured tooth or tubercle; the cutting edge inside of the teeth bears three tufts of hair-like setæ, the innermost (hindmost) being the longest. The first maxillæ (fig. 9) have the outer plate strongly curved on the outer margin, the distal portion of which carries a dense fringe of fine setæ; the end is furnished with seven (or eight) strongly chitinised teeth, which are dark brown in colour; the slender inner plate ends in five weak slightly curved teeth. The second maxillæ (fig. 10), as in other members of the sub-family, have the two plates anchylosed together throughout their length, and have the extremity of the inner margin produced into a brush-like process. The maxillipeds (fig. 11) have the characteristically large basal plate somewhat rounded on the outer margin, and carrying on the inner extremity a small, nearly square, plate, the rest of the limb not being developed; outside of, and obliquely placed to this, is the small palp of which the basal joint bears two small processes, while the terminal joint is small and is produced into a slightly fringed pointed apex. The large basal plate is always more or less ornamented by dark pigment.

The uropods (figs. 12 and 13), as seen from below, have their appendages very freely articulated to the basal plate, the inner and shorter one being placed usually anterior to the outer; the former has several and the lateral a few small marginal spines.

The species is now recorded for the first time from Tasmania.

Sub-Fam. *Ligiinea.*

9. *Ligia australiensis*, Dana.

This species was found by me in abundance under stones on the beaches in the neighbourhood of Hobart, and several specimens from the same locality were forwarded to me by Mr. Morton. These animals usually occur just above tide-marks, and run with great agility when their hiding places are exposed.

The species has not been recorded before from Tasmania.

Sub-Fam. *Scyphacinæ.*

Actœcia, Dana.

The generic character as given by me (in the Trans. N.Z. Inst. Vol. xi., p. 49), and which I adapted from Dana, is somewhat incorrect. I would alter it as follows:—"External antennæ stout, curved, five-jointed, with a three (or, counting the apex, four) jointed flagellum. Maxillipeds having the palp in the form of a slender acutely-pointed plate. Legs of the seventh pair as long as the preceding pairs."

10. *Actœcia euchroa*, Dana (Pl. II., figs. 1-8).

I found specimens of this little Isopod on the sea-beach between tide-marks at Eaglehawk Neck. They ran rapidly along the sand, and when pursued rolled themselves into a ball. The species is common on the New Zealand coast.

The few specimens found by me were very small, being less than $\frac{1}{6}$th of an inch (4 mm.) in length. In colour they were light gray with irregular black markings. Under the microscope the integument appears to be minutely scale-like, with a few short scattered spinules, particularly on the margins of the abdominal segments and on the appendages.

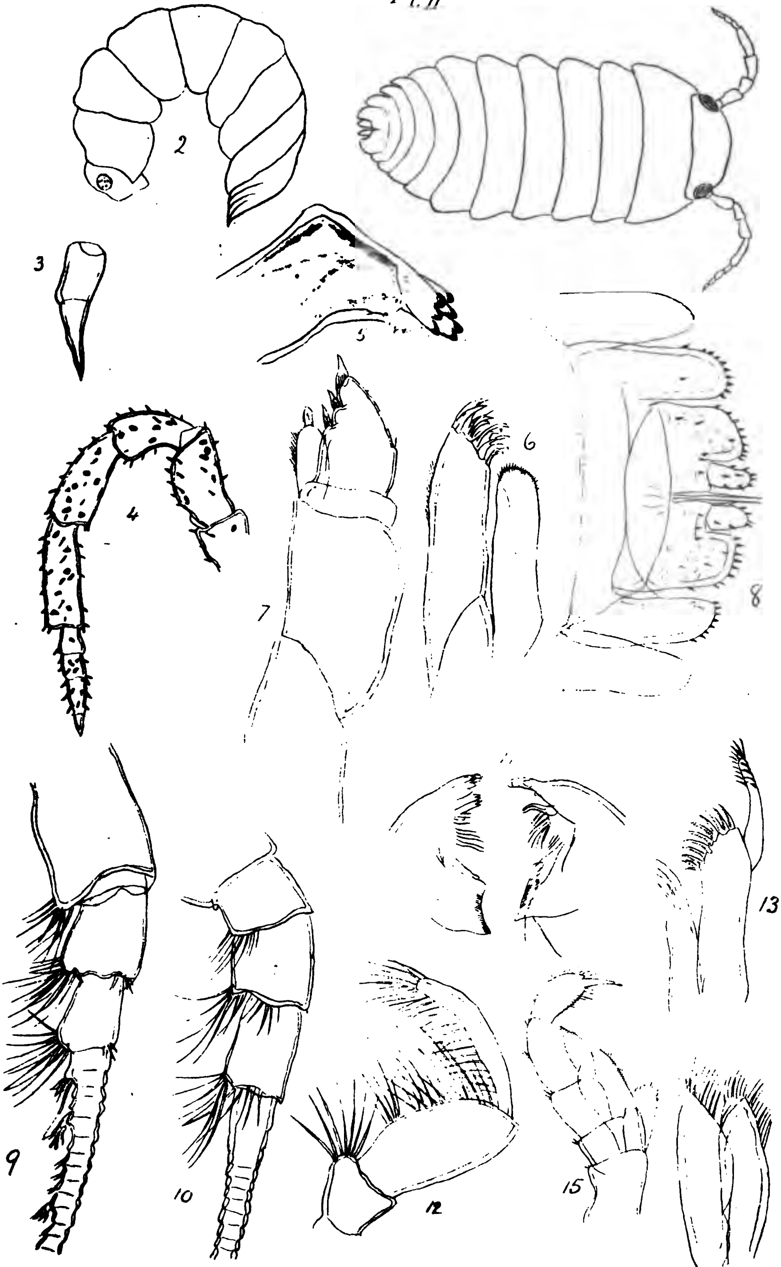
The first antennæ (fig. 3) are minute and indistinctly two-jointed; they are very difficult indeed to distinguish. The second antennæ (fig. 4) have a five-jointed base, with a four-jointed flagellum (counting the apical joint); all the articulations are dotted with numerous short spines. The mandibles (fig. 5) are strong and thick; at the apex is a stout bifid tooth, inside of this there are two simple teeth and then a strong trifid tooth standing at right angles to the cutting ridge of the limb; behind these stands a short comb-like process and a brush of fine setæ.

The first maxillæ (fig. 6) have the outer plate slender but armed at the extremity with about twelve acute curved spines; the inner plate ends in a rounded finely setose edge. (The second maxillæ were not seen, being lost in the dissection.)

The maxillipeds are stated by Dana to be two-jointed in the scyphacinæ, and the second joint to be lamellate; they are so figured for his *scyphax ornatus* of which he originally took the present species to be the young form. In *Actœcia*, however, they are four-jointed (fig. 7), the basal joint being very short and having the large second joint attached to it obliquely. There is no inner plate attached to the basal joint, but the second joint bears a small oval plate fringed at the extremity. The third joint is short and extremely indistinct, while the fourth is in the form of a flattened, acutely-pointed lamella fringed (not serrately toothed) on its inner edge.

The abdominal segments (fig. 8) are short, the last being

Pl. II



and capable of folding against the setose inner margin of the second joint.

First maxillæ (fig. 6) with outer plate long and narrow, very slender, and ending in one strong tooth, and three smaller ones; inner plate rudimentary with a minute terminal seta. Second maxillæ (fig. 7) somewhat dilated, ending in a feeble rounded lobe, and bearing on its inner extremity a very small uni-articulated process.

Maxillipeds (fig. 8) pediform, the terminal portion ending in a few (about four) small claws; the palp represented by a very small one-jointed process

The three anterior pairs of thoracic feet are furnished with sickle-shaped dactyli. The four posterior pairs are directed backwards and are elongated; the sixth and seventh pairs are the longest.

The basal part of the caudal appendages is produced backwards on its inner side into a long acute ciliated process; the external ramus is long, narrow, pointed and ciliated all round, it bears a row of spines on its outer margin; the internal ramus is about twice as broad; and is obliquely truncate at its widest part; it is ciliated all round, and bears a row of spines towards the extremity of both margins.

Length of the animal 15mm. (about $\frac{5}{8}$ inch.)

Fam. *Sphæromidæ.*

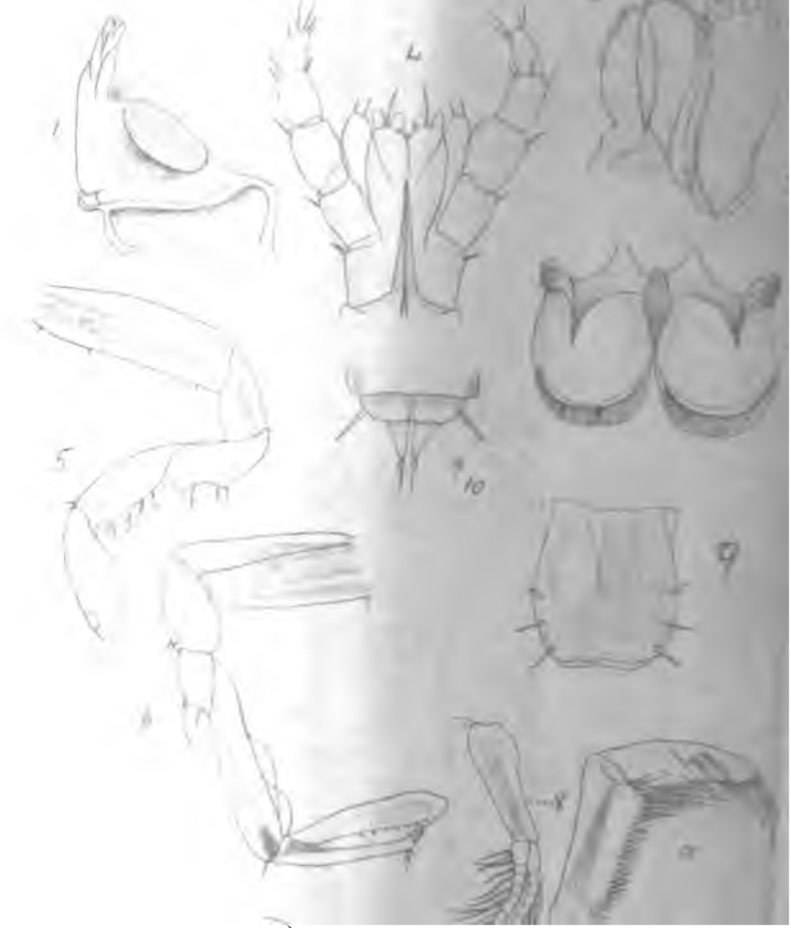
12. *Sphæroma gigas.* Leach.

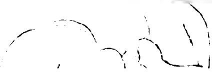
A small specimen, which I provisionally refer to this widely-spread Antarctic species, was picked up by me on the rocks between tide-marks at Pirates Bay, and a second from the same locality, collected by Mr. R. M. Laing, was handed to me by Mr. Chilton. It is identical with a species common on the East Coast of New Zealand, but, with them, differs in a few details from a large form, of which I have specimens from the Auckland Islands. In no group of Isopoda is there more need of a thorough revision of the genera and species than in the Sphæromidæ; and identification of many of the described forms is now a matter of extraordinary difficulty. This is chiefly owing to the fact that various naturalists have taken sexual characters as of generic importance, and have, consequently, in many cases placed males and females of the same species in genera. This species has not previously been described from Tasmania.

13. *Sphæroma quoyana.* M.-Edw.

I obtained a solitary specimen of this well-marked species between tide-marks on the Huon River, a little below Franklin. The species was originally described by Milne-Edwards, from specimens gathered on the coast of Tasmania by M. M. Quoy

Pl. IV





and Gaimard. It was also found by Heller (Voy. of the "Novara") at Sydney.

Fam. *Asellidæ.*

14. *Jais pubescens.*

Jæra pubescens. Dana: U.S. Expl. Expedn.
Crustacea (vol. ii., p. 744, pl. xlix.)

A number of specimens of this little Crustacean were found in the tube in which the specimen of *Sphæroma Quoyana* was placed. According to Dana, the forms originally described by him were taken at Nassau Bay, Tierra del Fuego, parasitic on *Sphaæroma lanceolata.* I have gathered this species at Auckland and Dunedin, and Mr. Chilton has recorded it from Lyttelton, all on the New Zealand coast. Mr. Chilton described his specimens under the name *Jæra novæ-zealandiæ* (Trans. N.Z. Inst., vol. xv., p. 189), the generic name being, however, changed to *Jæra* by Carl Bovallius ("Notes on the Asellidæ." Roy. Swedish Acad. of Sc.) We have since, however, discovered that our New Zealand form agrees with Dana's, and it therefore comes under Bovallius' genus *Jais*, the most distinctive character of which is the tri-unguiculate dactyli of the walking legs.

My Tasmanian specimens agree with those from New Zealand in most points. In Dana's brief description, the first pair of antennæ are said to be 4-jointed; in my specimens they are 6-jointed, which is also the case in the only other species of the genus, *J. Hargeri.*

Tribe *Amphipoda.*

Family *Orchestidæ.*

15. *Talitrus sylvaticus.* Haswell (Pl., iv., figs 1-10).

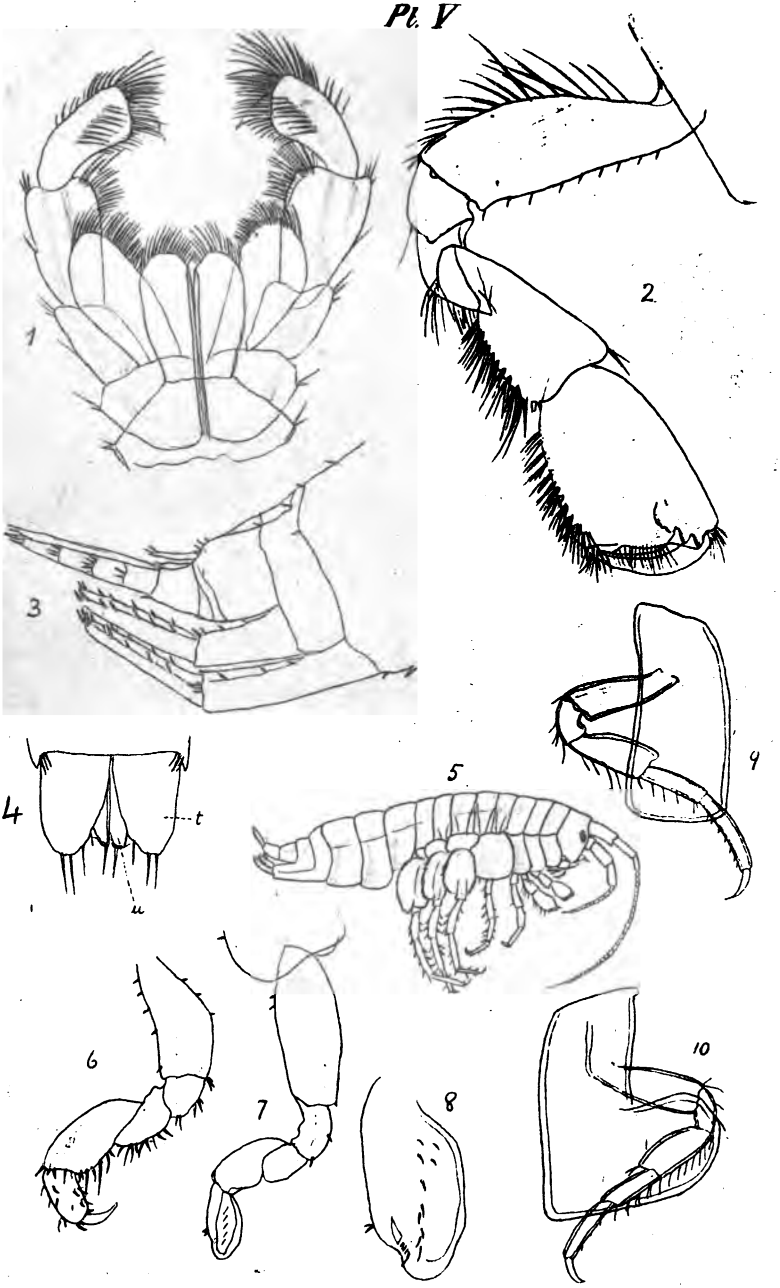
This terrestrial species was originally described from New South Wales, where, according to Professor Haswell, it is "abundant on moist ground, in wood and scrubs." He adds;—"I have received specimens obtained by Mr. Geo. Masters, from Rootyhill (a point about 30 miles from the coast) where it is very common; how much further inland its range may extend I have no exact data to enable me to determine; probably it is confined to a maritime belt of moderate breadth, as I am informed that it is not met with in the far interior." I think that perhaps the long and severe droughts, to which the interior of Australia is liable, would prove more effective barriers against the spread of Amphipoda, than either distance or even ranges of mountains. He goes on to say: "I have never observed it on the sea-shore." The Tasmanian specimens in the Australian Museum, Sydney, originally described by Haswell as *T. affinis*, were collected by

Mr. Kendall Broadbent, but no precise locality is given. Mr. C. Chilton writes me (June 13th, 1892): "I have an abundance of specimens from two situations on the Mount Kosciusko plateau"; these were collected by Mr. R. Helms. I collected several specimens among dry leaves, moss, etc., in the bush on the slopes of Mt. Wellington, a short distance above "The Springs," at a height, therefore, of about 2500 feet; and I have since received numerous specimens, collected by Mr. Morton from the same locality, as well as from other parts in the neighbourhood of Hobart.

By the kindness of Prof. Haswell, I have been enabled to compare my specimens with types of the New South Wales form, to note any differences, and to amplify the description in the catalogue of the Australian Crustacea.

Both pairs of *antennæ*, as is the case in most or all Amphipoda, vary considerably in length and in the number of the joints of the flagella, according to the age of the individuals. This character, it seems to me, has generally been accorded too much importance as a basis of classification in this group. The Australian specimens, however, are more strongly setose than the Tasmanian, and this feature prevails throughout most of the appendages. The *upper lip* is large, rounded and prominent. The *mandibles* (fig. 1) are slightly different in the two forms, my Tasmanian specimens having the molar ridge more prominent and less cup-shaped than the others, while the ciliated spines are fewer. The *lower lip* (fig 2) is of a more or less uniform type in all Orchestidæ; the outer edge has a finely corrugated border, which is very marked in some of my specimens. The *maxillæ* are normally developed; the *first pair* (fig. 3A) have the outer plate ending in about ten stout spines toothed on their inner edge, while the inner plate is slender and ends in two short spines; the *second pair* (fig. 3B) have both plates rounded at the end and fringed with fine spines. The *maxillipeds* (fig. 4) do not quite agree with Haswell's description; the inner plates are tipped with two rounded teeth (between which stands a seta) with a small tooth on the inner side; the outer plates, which are more slender and extend forward a little further, end in two short setæ; the three succeeding articulations—forming the so-called palp—become slender proximally and bear very few setæ, while there is only the rudiment of a blunt terminal joint (dactylos?). The *posterior gnathopoda* (fig. 6) in the male show some points of difference—best seen by reference to the figures. The dactylos is rounded, and the point of contact with the margin of the propodos marked by a few minute hairs. The propodos tapers to a rounded end, and its upper edge is thin and flange-like, as are the projecting processes of the carpus and meros. In my Sydney specimens (fig. 5) the flanges on the lower side of

Pl. V



the carpus, and the tubercular projection of the meros are protected by a few small spines. In the Mt. Wellington specimens, on the other hand, the flanges on the carpus are thinner and more flattened; the meral projection is also flange-like and rounded, and the whole limb is almost destitute of hairs. The *pereiopoda* are generally simpler and less spinous in the Tasmanian than in the N.S. Wales form. The branchiæ of the *fifth* pair in the males (fig. 7) are peculiarly modified. I cannot find any reference to this structure in any other of the Orchestidæ, and would provisionally suggest that they serve as a sort of clasping organ to assist in copulation. In the largest specimen examined they were curled up, instead of being somewhat flattened, as they appear in the figure. I am not sure, also, whether they are equally developed on both sides of the body. The *pleopoda* are reduced to a very rudimentary condition. The *first* pair (fig. 8) have both branches developed, but they are small and feeble, and the setæ are extremely slender; the *second* pair are still smaller and more feeble, while I have failed to find the third pair at all in those specimens examined. This defective condition is probably due to the terrestrial habits of these Crustacea, as in aquatic Amphipods these appendages serve as swimmerets, and aid the animal in forward progression. In terrestrial forms this function being no longer required, the necessity for the organ ceases, and it has accordingly retrograded in its development. The three pairs of *uropoda* (posterior pleopoda of most authors) are much as figured in Haswell's original paper (Proc. Linn. Soc. N.S.W., vol. iv., pl. vii., fig. 1) the ante-penultimate pair being much the longest, and reaching furthest back. The *telson* (fig. 9) appears to me to be quite entire, rounded at the extremity, and furnished with *three* small spines on each side. There is a delicate longitudinal median line visible with a high power, but this is due to the paired organs underneath showing up through its semi-transparent substance. I can detect no trace of cleavage of the organ. Close underneath it lie the very short ultimate *uropoda* (fig. 10) with their conical terminal joint, ending in a single spine. Looking at the telson from above, the extremities of these appendages slightly protrude, and this, probably, led Prof. Haswell to conclude that the telson was "cleft in the middle line posteriorly."

The specimens found by me were yellowish or yellowish-brown in colour. The largest was $\frac{4}{10}$ inch (or 10 mm.) in length.

16. *Talorchestia diemenensis.* Haswell (Pl. v., figs. 6-8.)

This species is relegated to the genus *Orchestia* by the Rev. T. T. Stebbing (Ann. & Mag. of Nat. Hist., Oct. 1891, p. 325) —"Since both the figure and the description show that the first gnathopod in the female is not simple, but sub-chelate, that is to say, it has the precise character which separates *Orchestia* from *Talorchestia*." Unfortunately the figures which accompany Haswell's original description (in Proc. Linn. Soc. N.S.W., vol. iv., pl. vii., fig. 6) are too imperfect to be of any value for reference, while the description of the female gnathopod (l.c. p. 248) is by no means clear, and may easily stand the interpretation put on it by Mr. Stebbing. In specimens examined by me, the first gnathopod in the female is simply unguiculate (fig. 6) while the second (figs. 7 and 8) is imperfectly sub-chelate. There is no doubt, therefore, that Prof. Haswell is correct in his identification of this species as a *Talorchestia*.

The species is apparently abundant on the beaches between tide-marks, as I have numerous specimens taken from the undersides of stones in the Derwent and Huon estuaries, and from Pirates Bay. I have also one large female specimen, caught in a rock-pool at Pirates Bay, which looks different in general appearance, but appears in details of structure to assimilate so closely to this species that I am unable to separate it. It is fully half an inch long, and has the whole anterior part of the body more tumid than my other specimens. The New Zealand *Talorchestia quoyana* and *T. tumida* are species which cannot bear immersion in water, as they drown in a short time. This Tasmanian species appears to resemble littoral species of orchestia in this respect.

17. *Hyale rupicola.*

Allorchestes rupicola. Hasw. (Proc. Linn. Soc. N.S. Wales, vol. iv., p. 250, pl. viii., fig. 1.)

Specimens of this species were obtained by me from under stones between tide-marks in the neighbourhood of Hobart. They differ from specimens taken in Port Jackson, and kindly sent me by Prof. Haswell, in having the inferior antennæ stouter and more densely fringed with setæ on the lower margin. Prof. Haswell has not described the differences in the sexes; his description of the gnathopoda applies to the male only.

In the females the first gnathopod very closely resembles the corresponding limb in the male, but is smaller. The second gnathopod is also very similar in general form, but is considerably larger than the limb anterior to it, and has a somewhat similar ciliated projection on the lower side of the carpus. The so-called marsupial plate is large, rounded in front, ending in an acute postero-inferior angle, and is finely fringed all round with cilia. The coxal plate of the same limb is nearly circular, and its margin is quite smooth.

This species has not hitherto been recorded from Tasmania.

Fam. *Lysianassidæ*

18. *Lysianax stebbingi* * n. sp. (Pl. iii, figs., 9-18; Pl. v., figs. 9 and 10.)

The species is founded on a single specimen (a male) which was obtained in a rock-pool at Pirates Bay by Mr. R. M. Laing, and was handed to me by Mr. Chilton. The following is the specific character:—

Head, with a very minute rostrum, lateral lobes rounded; the back is smooth; eyes large, somewhat reniform, with very numerous ocelli; anterior antennæ stout, almost pyriform; peduncle longer than flagellum; second antennæ long and smooth; mandibles smooth at the apex, without cutting teeth; maxillipeds, with the outer plate, large, rounded and entire; dactylos of second pair of gnathopoda almost obsolete; last pair of uropods very short, inner ramus rudimentary.

The *first antennæ* (Pl. iii., fig. 10) are as long as the head and first segment of the thorax; the first joint is very stout, one-third the length of the whole appendage, and quite smooth; the second and third joints are shorter and less swollen, and together only about two-thirds as long as the basal joint; the second with a few setæ on the lower margin; flagellum, about ten-jointed, tapering to a very fine point, each joint bearing a few setæ; secondary appendage, about six-jointed, rather shorter than the principal flagellum.

The *second antennæ* are as long as the head and three anterior thoracic segments; the peduncle is short, and has the fifth joint bent, almost at right angles with the fourth, so that the rest of the limb is bent back along the side of the body; the flagellum is long and many (30-40) jointed, the joints are as broad as they are long, and are destitute of setæ.

The *mandibles* (fig. 11) end in a smooth point, and have about five minute blunt spines on the margin behind it; the molar tubercle is verv feeble; the three-jointed palp is placed at a considerable distance from the apex of the limb; the second joint is the longest, and bears three small setæ near its extremity; the third joint is longer than the very short first one, and has about four small terminal setæ.

The *first maxillæ* (figs. 12 and 13) have the outer plate ending in about ten or eleven spines pectinately, toothed on the inner margin; palp very slender, ending in one long seta; inner plate short, ending in a minute seta.

The *second maxillæ* (fig 14) have the outer plate narrow, and ending in about ten very slender spines; inner plate, broader, with rather more spines, which are stouter and slightly shorter.

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* In compliment to the Rev. Thos. R. R. Stebbing, author of the Report on the Amphipoda of the "Challenger" Expedition.

The *maxillipeds* (fig. 15) have the basal plate elongated, notched at the apex, and finely setose on the margin; the outer plate is large, rounded, and has the margin perfectly entire, except below the middle of the inner side, where it bears two or three minute spines; the palp reaches a little beyond the outer plates, and has the joints finely setose.

The *first gnathopoda* (fig. 16) are simple and pediform ; the side plates are large, and are produced anteriorly ; the basos is straight; the ischium short, and the meros is sub-equal to it in length, and is produced on the lower setose margin into a conical projection ; the carpus is rather longer, convex above, with tufts of setæ at the upper and lower extremities ; propodos longer than carpus, tapering to the end, and with tufts of setæ on the lower margin ; dactylos slightly curved, simple.

The *second gnathopoda* (figs. 17 and 18) are long and slender ; the basos is long and narrow ; the ischium about half as long, articulated almost at right angles to it, and with one terminal seta ; the meros again is jointed almost at right angles to the ischium (so that the rest of the limb—in the dead specimens—is nearly parallel to the basos), and bears one long seta and a fringe of very minute hairs on its lower margin ; the carpus is about as long as the ischium, is fringed with minute hairs on both surfaces, and bears two or three long setæ at the extremity of its upper and lower margins ; the propodos is oval, broader than the carpus, but little more than half as long ; it is fringed with very minute hairs on its lower margin, and on the upper half of its upper margin bears a number of long setæ ; the dactylos is curved, and so small at to be almost undistinguishable even when magnified 150 diameters.

The *first pereiopoda* (Pl. v., fig. 9) have the side-plate nearly rectangular in form, and twice as deep as it is broad. In the *second* (Pl. v., fig. 10) the side-plate is the same depth, but the lower half is produced backwards as a rounded lobe, at right angles to, and twice as broad as, the upper half. The limb of the first pair is rather longer and more slender than that of the second ; both are furnished with a few slender setæ on the lower side of the ischium, meros, and carpus. The *third pereiopoda* are somewhat shorter than the two anterior pairs ; the side-plates are only about half as deep as those of the second pair, but are considerably broader than deep ; the basos is posteriorly produced into a large rounded plate, while the meros is also produced into a broadened flange, which extends downwards at its apex, and ends in a seta ; the front margin of the basal joints is furnished with simple setæ. In the *fourth* and *fifth* pairs the side-plates are successively smaller, and the plates on the basos larger than in the third ; the margins also have short spines instead of setæ ; the dactylos of the last pair is slender and nearly straight ; in all the anterior pairs it is stronger and more curved. The *uropoda* decrease in length posteriorly, the last pair being very short; the outer branch of this pair ends in a stout terminal, and two short lateral spines, the inner is short and quite rudimentary; the telson appears to be cleft to the base, and each lobe to end in two small spines. Unfortunately my observation was made from the side, as I had mounted my only specimen as a permanent slide before I observed this detail from above.

Length, 6 mm. (about $\frac{1}{4}$ inch).

Colour, nearly white.

Integument, very hard and brittle, without any markings.

Fam. *Atylidæ*.

19. *Atyloides tasmaniæ*. Nov. sp. (Pl. ii., figs 9-15; Pl. iii., figs. 1 and 2.)

The specimens referred to this genus agree in nearly all respects with Stebbing's definition (" Challenger " Amphipoda, p. 913). In the first antennæ, however, I can discover no trace of the small accessory flagellum; but this is such a small organ, that, except in dissected specimens, it would be easily overlooked. The first maxillæ, also, have only about six setæ on the inner plate, in this respect resembling Stebbing's genus, *Atylopsis*, from which, however, it differs in not having the upper lip bilobed.

The body is compressed, perfectly smooth (minutely rugose under a high power), and not in any way carinated dorsally. The front of the cephalon is hardly produced between the rather large subquadrate eyes.

The *first antennæ* (fig. 9) are about half as long as the body; the joints of the peduncle are short and broad, diminishing in size distally, and are densely tufted on the ends of the lower margin with setæ; the flagellum is nearly twice as long as the peduncle; the joints are broader than long, and at intervals of half a dozen or more (fewer at the proximal end) occurs a broader joint tufted with the auditory (?) setæ so characteristic of this and allied genera. In one dissected specimen the flagellum had about forty articulations.

The *second antennæ* (fig. 10) are sub-equal in length with those of the first pair; the second joint of the peduncle has a stout spine at its lower extremity, while the next three joints are sub-equal in length, and are tufted with numerous setæ on the end of the lower margin; the flagellum is between two and three times as long as the peduncle; the joints are very numerous, are broader than long, and about every second is tufted with minute setæ; the *upper lip* is rounded and not incised.

The *mandibles* (fig. 11) have seven slender spines serrated on the convex margin on the spine-row; the molar tubercle is large, and is crossed by about twenty lines of serrations; its inner edge is defined by a tuft of small spines; the palp (fig. 12) has the second and third joints sub-equal in length; the basal joint is broadened distally, and has numerous strong spines on its inner margin; the second joint is fringed with two rows of setæ, especially towards the distal end, thus forming a kind of sheath, into which the somewhat falcate third joint can be bent; this last joint is setose on the inner margin, and ends in about nine spines, of which the inner four are pectinate.

The *first maxillæ* (fig. 13) have the inner plates small and furnished at the extremity with *six* plumose setæ; outer plates, with about ten stout spines, more or less toothed on their inner margins; outer joint of palp fringed with about ten toothed spines, and a corresponding number of short, simple setæ.

Second maxillæ (fig. 14) having the inner plate fringed with about fifteen plumose setæ on the inner margin—both plates ending in fine setæ.

The *maxillipeds* (fig. 15) have the inner plates narrow, and reaching considerably beyond the extremity of the first joint of the palp, densely fringed with curved setæ, which hide the three short teeth at the apex; outer plates almost reaching the end of the second joint of the palp, also densely fringed round the ends and inner margins with spines and plumose setæ; palp densely setose.

First gnathopoda (Pl. iii., fig. 1) with the coxal plates rounded and very short; basos with numerous setæ near the base on the lower margin and at the distal end; the short ischium and meros are also thickly furnished with setæ; the carpus is nearly smooth on the upper margin, while the lower is considerably rounded, and is densely fringed on the edge and on both sides; the propodos is broader than the carpus, the distal half of the lower margin forming the oblique palm, which is defined by a group of three or four strong, straight spines on each side; the whole joint is furnished with tufts of short setæ on the upper, and numerous rows of long setæ on the lower margin, sides, and end; dactylos, slender and curved.

Second gnathopoda, somewhat similar to the first pair, and sub-equal in size with coxal plates, short and rounded; gill, large, not reaching to the meros; basos, long, straight, and with very few spines on the margins; ischium and meros short, the latter densely setose on its distal half; carpus nearly triangular, with its lower margin produced downwards and thickly setose; propodos, tapering distally, the palm defined by a group of four pairs of stout spines, the whole joint densely setose; dactylos, stout, minutely setose on the inner margin.

Pereiopoda, increasing in length posteriorly. Second pair with coxal plates broadened and rounded behind; third pair with coxal plate short, two-lobed, front lobe rounded, hind lobe produced somewhat downwards, and bearing three spines; fourth and fifth pairs with the coxal plate developed only as a posterior lobe; basal plates extended widely.

Pleopoda, with the peduncles smooth, their extremity produced—in some pairs at least—into a curved process beside the base of the outer ramus.

Uropoda (Pl. iii., fig. 2)—First pair with a long peduncle and short rami; second pair with peduncle not reaching to extremity of that of the preceding pair, rami sub-equal; both pairs furnished with a row of marginal spines on the peduncle, and three or four on the rami; Peduncles of the third pair much shorter than the telson; rami, sub-equal in length, broadly lanceolate in form and tapering to a very acute apex, fringed on both margins with numerous spines, each carrying a long plumose seta in its axil.

Telson, long, reaching as far as the extremity of the second pair of uropoda, cleft beyond the centre, the lobes slightly tapering and rounded at the ends, margins quite destitute of spines or setæ.

Length of the largest specimen, 7 mm. (about $\frac{5}{16}$th of an inch).

This species was found in rock-pools at Pirates Bay.

This species may belong to Boeck's genus, *Pontogeneia*, but differs in having the third joint of the mandible-palp nearly as long as the second, and in wanting the accessory one-jointed appendage to the first antennæ.

On the other hand, Stebbing defines *Atyloides* as having "spine-teeth (not slender spines) on the inner margin of the outer plate of the maxillipeds." In the present species the inner margin has slender spines and no teeth. The distinctions between the two genera seem to me altogether too slight.

Fam. *Gammaridæ.*

Genus Niphargus, Schiödte.

This genus was instituted in 1851, for the reception of an eyeless Amphipod, found in the subterranean waters of various parts of Europe. Spence Bate, in the British Museum Catalogue, gives us one of the characters of the genus "eyes minute," and describes four species, all subterranean. Czerniavski, in 1868, added a species from the Black Sea, with "oval, fairly large eyes," while Grimm obtained another, a blind species, in the Caspian, at depths of 35-90 fathoms.

Among the Crustacea examined by me in the present collection are two fresh-water species, which I think must be placed in this genus, though they are somewhat different in appearance, and diverge somewhat from the generic character of *Niphargus*, as defined by Spence Bate. On the other hand, neither is sufficiently distinct to justify the institution of a new genus for its reception, especially as the classification of the whole group is in want of revision. I accordingly place these forms here, pointing out under each species the features in which they differ from the generic character.

20. *Nipharyus mortoni*,* n. sp. (Pl. iv., figs. 11 and 12 ; Pl. v., figs. 1-5)

The specimens described here were first found by me in a small stream above Franklin, on the Huon River, at an elevation of 200 to 300 feet above tide-marks The stream at the time of my visit was a minute runnel of water, which had cut a subterranean channel in many parts, and only here and there showed itself above ground. The little Crustacea were somewhat difficult of capture. They were mostly found creeping about under the little stones and bits of wood in the stream; but, as soon as their hiding-places were disturbed, they abandoned themselves to the current, and were swept at once into darkness.

About the same time Mr. Laing, of Christchurch, N.Z., obtained one specimen (handed to me by my friend, Mr. Chilton) from the under side of a stone in a stream near The Springs, Mt. Wellington, that is is at an elevation of some 2000ft. More recently I have received a considerable number of specimens from Mr. Morton, who obtained them from the same locality. These were found clinging to the undersides of stones, pieces of wood, etc. There is some slight diversity amongst the different specimens from Franklin and Mt. Wellington, chiefly, however, in the relative number of hairs, setæ, etc., occurring on the different organs. Such variations are probably only individual or sexual.

The gnathopoda in this species, have not the propoda as broad as is usual in the genus. This, however, is not a feature of such importance as the fact that the telson is cleft into two distinct divisions, while in *Niphargus* it is a single telson, though deeply cleft. This, along with various other characters, induced me at first to place the species in the genus *Melita*, to which it approximates in many respects. But the latter genus is characterised *inter alia* by the great diversity of the gnathopoda in the two sexes, a feature which is quite wanting in the present form. The following are the specific characters :—

Body (Pl. v., fig. 5) greatly compressed; Coxæ of four

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*In honour of Mr. Alex. Morton, F.L.S., Secretary of the Royal Society of Tasmania.

anterior thoracic segments, as deep as the segments themselves, the three posterior not half as deep; fourth much wider than those in front of it; eyes small, oblong, close to the front margin of the cephalon; upper antennæ with joints of the peduncle sub-equal; lower, with the peduncle slightly shorter than that of the upper pair; maxillipeds, stout, with 4-jointed palp; both pairs of gnathopoda sub-equal, much compressed; terminal uropoda longer than the preceding pairs, inner branch almost obsolete; telson cleft into two portions.

The length of the largest specimen was $\frac{9}{10}$ inch (14mm.) The integument is generally smooth, but with a few minute hairs on the back and sides of the abdominal segments. The margins of the segments are also nearly quite smooth.

The *upper antennæ* were, in both instances, about two-thirds as long as the whole body; the joints of the peduncle were sub-equal in length, the middle one being slightly the longest; the flagellum, in most instances, was about twice as long as the base, but in one example it was quite short. This may, or may not, be a sexual difference; I could detect no other distinction in the animal. The secondary appendage was very small and 3-jointed.

In the *lower antennæ* the peduncle was rather shorter than the corresponding part in the superior pair; the fifth joint was rather shorter than the elongated fourth; the flagellum was composed of only some dozen joints, which were almost quite destitute of setæ, while those of the superior pair had only a few minute ones at the extremities.

The *mandible* palp (Pl. iv., fig. 11), which is three-jointed, has the basal joint, as usual, very short; the second is the longest, and has its lower margins broadened, flattened, and fringed in their proximal part. This seems to form a kind of sheath or hollow, into which the somewhat long terminal joint, which is beautifully setose along its lower margin, can apparently be folded.

The *first maxillæ* (Pl. iv., fig. 12) have the outer plate ending in about ten strong spines, the inner ones pectinately toothed on the inside; the inner plate is small, and carries four weak plumose setæ near its extremity; the palp is flattened, and placed nearly at right angles to the rest of the limb, its elongated second joint ends in a row of short spines.

The *second maxillæ* have the outer plate carrying numerous setæ at the extremity, while the smaller inner plate is fringed along the whole inner border.

The *maxillipeds* (Pl. v., fig. 2) are stout; the plates on the first joint are long, oval, and thickly fringed with setæ at the end; the plates on the second joint are larger, more rounded, and thickly setose on their inner sides; the palp is strong and four-jointed, with numerous setæ on the inside and extremities;

the claw, or fourth joint, is really two-jointed near its sharp apex.

The *first* and *second pairs of gnathopoda* (Pl. v., fig. 2) are sub-equal in size and form, and though distinctly sub-chelate are not very large; they have the basos long; the ischium and meros very short—the latter produced at its extremity into an acute point; the carpus broadening distally, with several tufts of setæ along its lower margin; the propodos sub-quadrate, with the palm obliquely transverse, and defined by a stout spine; dactylos, long, and slightly curved. Both pairs of limbs have the joints much compressed, and the propoda fringed with tufts of setæ, especially along their lower margins.

The *pereiopoda* increase in length posteriorly, are rather slender, with narrow basa, and have very short spinous setæ, which are only sparingly produced at the extremities of the joints.

The *uropoda* (Pl. v., fig 3) of the first and second pair, are sub-equal in length, and shorter than the outer branch of the third pair, which is very long, while the inner branch is so short as to be only seen with difficulty.

The *telson* (Pl. v., fig. 4) is cleft into two irregularly triangular portions, each tipped with a few spines; the number of the latter varying in different specimens.

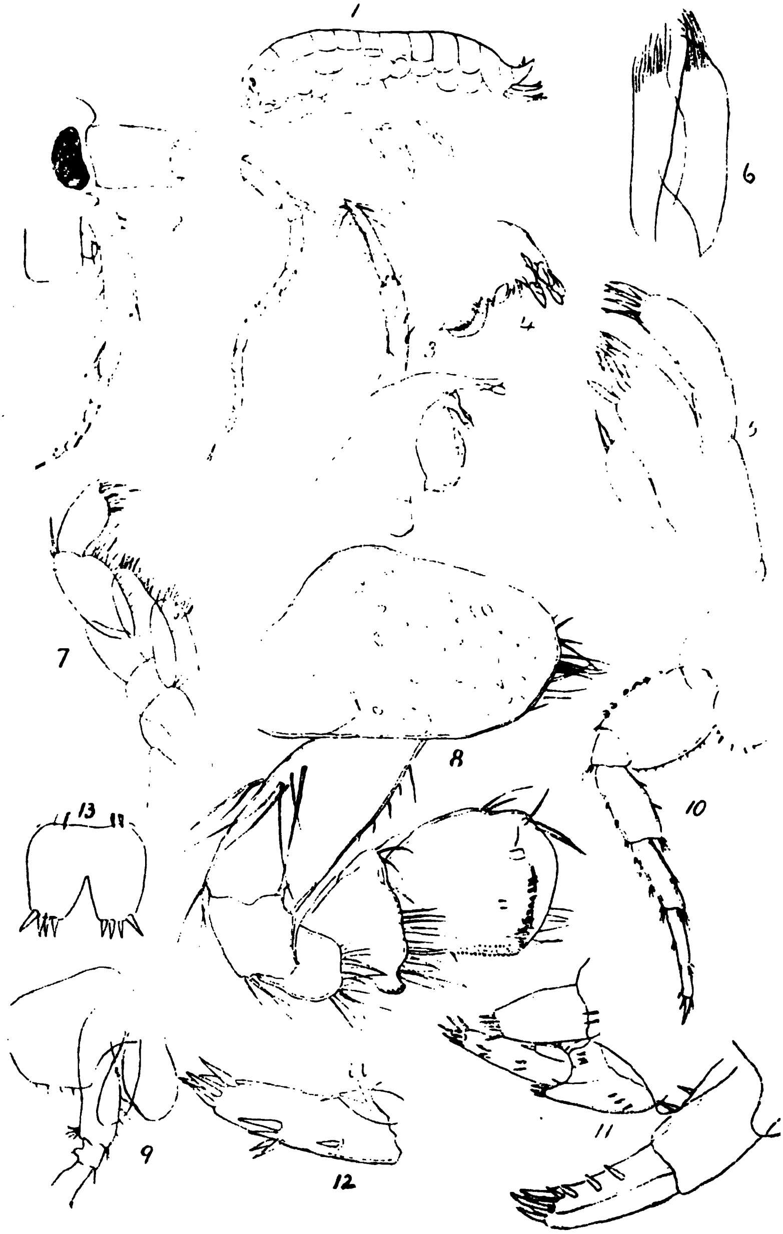
21. *Niphargus montanus*, n. sp. (Pl. vi., figs. 1-13.)

My first specimens of this interesting form were handed me by Mr. L. Rodway, who obtained them on the top of Mt. Wellington (4000ft). He had collected a bunch of sedges from some swampy ground near the summit, and on washing out the roots in a basin of water, observed a number of small amphipods swimming about; these he secured and handed to me. During this last winter, Mr. Morton made the ascent of the mountain, and obtained a considerable number of specimens from the pools, which were frozen over at the time.

The chief point in which this species differs from the generic character, is in the length of the last pair of uropods. These are hardly longer than those of the preceding pair; but, with this exception, it coincides very well with Spence Bate's definition. The following are the specific characters:—

Coxæ of four anterior segments produced considerably downwards, the posterior pairs only about half as deep; eyes, relatively large, subreniform, close to the rounded front margin of the cephalon; antennæ, short, superior pair not longer than the cephalon, and two anterior thoracic segments; lower pair with the joints of the peduncle sub-equal, and flagellum short; Maxillipeds, stout, with 4-jointed palp; both pairs of the gnathopoda sub-equal, with broad carpi and nearly square propoda; pereiopoda and uropoda furnished with short, very stout marginal spines; terminal uropoda, hardly longer than

Pl. VI



the preceding pairs, inner branch minute; telson cleft half-way to the base.

Length of largest specimens 6 mm. (about $\frac{1}{4}$ inch.) The colour varies from whitish-yellowish to brown, probably, according to the vegetation of the pools in which they occur. The integument is quite smooth.

The *first antennæ* (fig. 2) are about as long as the cephalon and two anterior segments of thorax; the first joint of the peduncle is stout; the second shorter and more slender; the third half as long, and not half as stout as the first; the flagellum is few (about 14-) jointed, and is somewhat longer than the peduncle; the secondary flagellum is very short and two-jointed.

The *second antennæ* are about half as long as the first; the peduncle only shows two joints, which are about two-thirds as long as the peduncle of the first pair; flagellum, about eight-jointed, shorter than peduncle; both pairs of antennæ have very few short hairs on them.

The mandible-palp (figs. 3 and 4) is three-jointed; the second joint has only a few short setæ on it; the third, which is sub-equal with it in length, is sparingly fringed with setæ on its lower margin and extremity.

The first maxillæ (fig. 5) end in six stout spines, which are all, more or less, pectinately toothed on the inner edge; the palp is stout, two-jointed, and ends in five short spines; the inner plate is rounded at the end and bears two slender terminal setæ.

The second maxillæ (fig. 6) are very thin and foliaceous, each plate ending in a number of slender setæ.

The maxillipeds (fig 7) have the plates on the first joint short, rounded, and bearing four blunt teeth and numerous setæ at the extremity; the plates on the second joint are also rather short and rounded; the inner edge at the extremity carries five short, blunt teeth, outside of which are five rather long and stout spines; the four-jointed palp has numerous setæ on its inner margin, while its third joint bears a small rounded tubercle.

The gnathopoda (fig. 8) are sub-equal in size and form in both sexes; the side-plates are deeper than broad, are evenly rounded, and carry a few fine setæ on the lower margin; the straight basos has a few long, slender setæ on the posterior margin; the meros is short; the ischium still shorter, and fringed with setæ on its distal margin; the carpus broadly triangular, and carrying a few setæ along its lower edge; the propodos is nearly square, its upper edge is slightly rounded, and bears a few cilia; the lower edge is rugose; the transverse palm is fringed with minute teeth, and ends in two or three stout spines.

The pereiopoda (figs. 9 and 10) increase slightly in length to the fourth, which is the longest, the fifth being rather shorter; all the joints are furnished with clusters of short, acute spines; the side-plate of the first pair resembles those of the gnathopods; that of the second pair is broad and excavate in front; the third is two-lobed, the posterior lobe being the largest and having five or six short marginal spines.

The first and second uropods (fig. 11) reach almost as far back as the extremity of the third pair; the last has the outer branch well developed, but shorter than is usual in the genus; the inner branch (fig. 12) is represented by a minute lobe tipped with a single seta; the telson (fig. 13) is cleft half-way to the base, each division ending in four short spines.

22. *Mæra fasciculata*, mihi.

Megœmera fasciculata, mihi (Ann. and Mag. of Nat. Hist. Ser. 5, vol. vi., p. 5, pl. i., fig. 5.)

Some small specimens of this species were collected by Mr. R. M. Laing in shallow pools between tide-marks on the Huon river. They agree very closely with specimens from New Zealand.

This species agrees with Boeck's definition of *Mæra*, except in regard to the second gnathopoda, which have *not* the hand "much larger than in the first pair." It is somewhat larger, but not more than half as long again, the breadth in both being about the same.

The species has been found abundantly on the east coast of New Zealand (South Island) by both Mr. Chilton and myself.

Addendum.

In Budde-Lund's Crustacea Isopoda Terrestria, p. 285, a species of *Armadillo* is described from Tasmania, unfortunately, without figures. I append here a translation of his description. The species belongs to the section of the genus, characterised by him as follows:—

"External terminal rami of the anal feet obliquely tetragonal (trapezoidal), usually much smaller and shorter than the basal articulation, rarely equal in size; epimera of the first segment of the body simple, slender; anal segment of the abdomen triangular, with the apex more or less acute."

Armadillo misellus.

Oblong-oval, very convex, opaque (?); body everywhere distinctly tubercled; the whole surface minutely pubescent.

External antennæ rather shorter than half the body; flagellum 5-articulate, shorter than the peduncle; first articulation of the flagellum rather shorter than the next three.

Clypeus, with shorter lobes, sub-triangular, epistome somewhat convex, with the superior margin not reaching beyond the front.

First segment of the body with the lateral margin thickened, slightly revolute, somewhat furrowed longitudinally, subequally cleft behind; epimera of the second segment cleft, interior part short, toothed; posterior margin of the first three segments slightly sinuate on both sides.

Anal segment of the abdomen not broader than long, contracted in the middle, posterior margin nearly straight, with the external angles rounded, nearly straight (?); basal articulation a little longer than broad, external branch shortest, inserted above the broader internal; internal branch somewhat shorter than the anal segment.

Colour, greyish.

Length, 8 mm.; breadth, 3·75 mm.; height, 2 mm.

The specimen described, which was taken in Tasmania by Dr. Scheyer, is presented in the Berlin Museum.

A somewhat allied species (*A. vulgare*) is described by Budde-Lund as having been collected at Melbourne.

EXPLANATION OF FIGURES.

Plate I.

Figs. 1 & 2. Engæus cunicularius.
1. Female, nat. size. (The abdomen is too broad in the figure.)
2. Rostrum (mag.)

Figs. 3-5. Gebia simsoni.
3. Animal, nat. size.
4. Rostrum, from above x3.
5. Telson and uropods spread out, x2.

Figs. 6-13. Oniscus punctatus.
6. First antenna, x40.
7. Second antenna x10
8. Right and left mandibles, x56.
9. First maxilla, x56.
10. Second maxilla, x56.
11. Maxillipeds, x40.
12. Extremity of abdomen from below (*an*-anus) x19.
13. Uropod, x26.

PLATE II.

Figs. 1 to 8. Actœcia euchroa.

1. Outline of animal, x10.
2. Same from above, x10.
3. First antenna, x56.
4. Second antenna, x40.
5. Mandible, x56.
6. First maxilla, x56.
7. Maxillipeds, x56.
8. Last segment of abdomen and uropods, x40.

Figs. 9-15. Atyloides tasmaniæ.

9. First antenna, x40.
10. Second antenna, x40.
11. Mandibles, x56.
12. do. palp, x56.
13. First maxilla, x56.
14. Second maxilla, x56.
15. Maxilliped, x40.

PLATE III.

Figs. 1 & 2. Atyloides tasmaniæ.

1. First gnathopod, x26.
2. Telson and last pair of uropoda, x26.

Figs. 3-8. Rocinela spongicola.

3. Animal, dorsal view, x3.
4. Mandible, x26.
5. Extremity of mandible, x56.
6. First maxilla, x41.
7. Second maxilla, x41.
8. Maxilliped, x41.

Figs. 9-18. Lysianax stebbingi.

9. Outline of body, x9.
10. First antenna, x41.
11. Mandible, x41.
12. First maxilla, x41.
13. Extremity of same, x184.
14. Second maxilla, x41.
15. Maxilliped, x41.
16. End of first gnathopod, x41.
17. Second gnathopod, x41.
18. Hand of second gnathopod, x125.

PLATE IV.

Figs. 1-10. Talitrus sylvaticus.

1. Mandible, x56.
2. Lower lip, x84.
3. Maxillæ (*a*) first pair; (*b*) second pair, x56.
4. Maxillipeds, x56.
5. Second gnathopod of male (Sydney specimen), x13.
6. do. do. do. (Mt. Wellington specimen), x13.
7. Fifth pereiopod, x40.
8. Pleopod of first pair, x40.
9. Telson, x56.
10. Last pair of uropoda, x56.

Figs. 11 & 12. Niphargus mortoni.

11. Mandible-palp, x40.
12. First maxilla, x40.

PLATE V.

Figs. 1-5. Niphargus mortoni.

1. Maxillipeds, x40.
2. Second gnathopod, x26.
3. Extremity of abdomen from the side, x17.
4. Telson (*t*), with inner branch of last uropod (*u*) from above, x28.
5. Outline of body (of female), x5.

Figs. 6-8 Talorchestia diemenensis (female.)

6. First gnathopod, x26.
7. Second gnathopod, x26.
8. Hand of second gnathopod, x56.

Figs. 9 & 10. Lysianax stebbingi.

9. First pereiopod, x26.
10. Second pereiopod, x26.

PLATE VI.

Figs. 1-13. Niphargus montanus.

1. Animal, x7.
2. Front of head and antennæ, x41.

Figs. 3 & 4. Mandibles, x56.

5. First maxilla, x125.
6. Second maxilla, x125.
7. Maxilliped, x56.
8. First gnathopod, x56.
9. Second pereiopod, x26.
10. Third do. x26.
11. Two last uropods and telson, x56.
12. Last uropod, showing the inner branch (i.b.), x125.
13. Telson, from above, x56.

Phreatoicus australis. Chilton.

Post Scriptum.

In putting aside my specimens, described in this paper, I found in the tube containing *Niphargus montanus*, collected by Mr. Rodway, a single immature specimen of the remarkable Isopod, *Phreatoicus australis*. The specimen was only about 4 mm. (a little over $\frac{1}{6}$ inch) in length. The occurrence of this species adds another to the singular group of forms found in the pools on the top of Mt. Wellington. The genus was established in 1882 by Mr. C. Chilton, for the reception of a blind subterranean Isopod—*P. typicus*—which occurs in wells in Canterbury, New Zealand. In 1889, Mr. Chilton received a small collection of Australian Crustacea, and this included a new species of *Phreatoicus* (*P. australis*) from Mt. Kosciusko, at a height of 5,700 feet.

I have already pointed out that the characters of *Anaspis*, possessing, as it does, an extremely generalised structure, lead to the conclusion that it is of great antiquity. The same evidence is borne by the occurrence of *Niphargus montanus.*

The evidence of the antique character of this fresh-water fauna is still further strengthened by *Phreatoicus*. The distribution of the genus is, in the first place, remarkable, one blind species occurring in New Zealand, and another possessing well-developed eyes, in two such widely separated localities as Mt. Wellington (4,100ft.), in Tasmania, and Mt. Kosciusko (5,700ft.), in south-eastern Australia. And, again, *Phreatoicus* is a highly generalised Isopod, resembling the *Asellidæ* perhaps more than any other family, but sufficiently distinct to be separated as the type of a new family, the *Phreatoicidæ.*

Probably an examination of other streams and pools at high elevations in Tasmania and Australia will reveal further examples of this interesting archaic fresh-water fauna.

NOTE ON A TASMANIAN "ACANTHIZA"

(Bush Tit).

[By Colonel W. V. Legge, F.Z.S., late F.L.S.].

Gould has figured in his work three species of Acanthizas from Tasmania, viz: the two common and well-known birds, *Acanthiza chrysorrhœa,* and *A. diemenensis*—the "Yellow tail" and "Brown tail"—and a third, *A. ewingi,* Ewing's Acanthiza. This latter species, figured on Plate 35, vol. iii., B. of Australia, is stated to differ from *A. diemenensis* in being a slenderer bird, with a proportionately longer tarsus, and in having a rufous band on the wing, formed by the basal portion of the outer ribs of the primary feathers. It has, however, been expunged from modern treatises on Australian Avifauna, for Mr. Sharpe, in his "Catalogue of Birds," vol. vii., p. 295, unites it with *A. diemenensis,* and Dr. Ramsay has omitted it from his "List of Australian Birds." That there are, however, two species of "Brown tail" in this island is, I am of opinion, tolerably certain, but being closely allied and a sufficient series for comparison not being extant in the national collection at the British Museum, Mr. Sharpe failed to recognise their distinctness. For many years past but little attention has been paid to the smaller species of Tasmanian birds, and comparatively little scientific work done among them. There is, unfortunately, no carefully formed collection of Tasmanian birds in the skin existing in the colony, and very few field notes have been made on the smaller species of forest birds, save in the direction of oology. The consequence is that such points as the specific distinctness, or otherwise, of two little noticed species like these in question is more than likely to have been passed over.

Last December, when visiting an out-of-the-way settlement on the Elephant Hill, near St. Mary's, situated about 1,500 feet above sea level, I met with a solitary bird hopping about the scrub and bushes, on the edge of a clearing, and being attracted by its peculiar note, I procured it, having by chance my gun with me. It proved to be a small Acanthiza, very similar to the common "Brown tail," or Tasmanian Acanthiza, but differing in having the forehead pale rufescent grey, instead of rufous, and the throat and foreneck with the markings much less pronounced than in the last-named species; in fact the colouration of that part is almost uniform, the centres of the feathers being also slightly darker than the rest of the web. At the base of the outer webs of the primaries there is a narrow rufous band, similar to that shown in Gould's figure, which, however, has the markings of the throat more pronounced than in my specimen, owing to the absence of throat markings. I was inclined to look on the bird as an immature male of the common Brown Tail, particularly as the month was that in which so many young birds are procurable, but the actions and note of this individual were so totally different from that of the Tasmanian Acanthiza that no doubt is left in my mind as to its distinctness. The common species is gregarious, nearly always being found in little parties, which flit about with great zest and activity, uttering in unison their peculiar little note, which may be syllabised, *zit, zit, zit, whoorl,* the latter being somewhat gutteral. The note of my new species resembles, *tit, tit, too, woo,* the latter syllables being soft and melodious.

The dimensions of this example were as follow:—

Length, 4·0 inches; wing, from carpal joint, 1·9; tail, 1·9; tonces, 0·75; bill, to gape, 0·45. Iris light red (paler than in the common species); bill, brown, slaty at the base; legs and feet dark olive brown. The contents of the stomach were small ants and minute coleoptera, mixed with some curious globular masses, resembling hard seeds. There can be little doubt that this bird is, in reality, the *Acanthiza ewingi* of Gould; which should, therefore, be reinstated in the Tasmanian avifauna.

NOTE ON THE VORACITY OF THE KELP FISH.

While fishing for crayfish recently, on the East Coast, I caught a couple of so-called "Kelpfish" in the net. This fish, belonging to the family *Labridæ,* is a favorite bait with fishermen for the crayfish caught in hand nets, and is found in moderately shallow water, sometimes, and at others in deep pools, but always in beds of kelp. On opening the individuals I caught I was surprised to find their stomachs full of the small white, conical, and calcareous shells which cover the tops and sides of rocks, which are covered at high water; but among these were also moderately large limpet shells swallowed whole, the fish, in some instances, being still attached to the shell. Enclosed are some of these shells from the stomach of one of the fish, which was about 1½lb. in weight. I examined its strong, circular teeth, and found one tooth gone at the point of each jaw, evidently wrenched out by the force of grasping such a strongly attached shellfish as the limpet. But great as the strength required to detach a limpet, it must be nothing to the grinding, gnawing motion required to tear off the small, scarcely protuberant calcareous shells first mentioned, and with which the stomachs were pretty well filled.

It is a singular trait in the economy of this fish, which leads it to subsist on such an apparently unappetising mass as had formed the meal of these examples just prior to my catching them.

ON THE OCCURRENCE OF SOME AUSTRALIAN *ARCLEIDÆ* IN TASMANIA.

The past summer and autumn have been marked by a special visitation of two species of Australian Herons to Tasmania. One, the White Egret, *Herodias alba*, Linn., which has hitherto been an occasional straggler to the island, has occurred in considerable numbers during the summer, both in the north and south. The other, *Ardea pacifica*, Latham, a rare visitant to Tasmania, has been half a dozen times met with in the north during the past two months.

The localities visited by the White Egret appear to have been the basin of the Derwent, including the Sorell district, the Midlands, and the vicinity of the Tamar and Esk rivers in the north. Mr. T. Carr, a prominent member of the Northern Science Association, informs me that he has had numerous examples brought to him, which has also been the case as regards the Hobart Museum, which testify, unfortunately, to the old story in England: that as soon as a new bird appears on the landscape, it is shot down by every pot-hunter who meets with it. More of these handsome white visitors have doubtless been immature birds, which might have remained in the island, and, in any case, would have returned another year; their destruction, therefore, means the partial driving away of an interesting, permanent addition to our avifauna. This species is so widely distributed that there is no reason why it should not become a resident in the island, breeding at the more retired lagoons and morasses of the lake district. It may not be out of place to glance here at the geographical distribution of the White Egret. The union of the Australian form, *Herodias syrmatophorus* of Gould, with the widely-distributed *Herodias alba* of Linnæus, very widely extends the range of the species under consideration. The former was separated by Gould from the old world species on account of its small size, and for a like reason, the bird commonly found throughout India was given specific rank by that herculean worker in Indian ornithology, Mr. Allen Hume, C.B., the editor of the now defunct "Stray Feathers." An examination, however, of a large series got together from various parts of the world, such as that in the national collection at the British Museum, shows that the Indian, Chinese, and Australian and, perhaps, the African representatives of the species are all, more or less, diminutive in size, while the larger race inhabits Central Asia, Russia, the Delta of the Nile, and Syria. Examples in the British Museum, from Kashgaria, Russia, and measured by me, gave a length in the wing of 17·6, 8 inches respectively, while a specimen of the met with in India (and probably straying south from Kashgaria), reached a length of of 17·0 inches in the wing. On the other hand, North African, Chinese, and Australian specimens measured in the wing, 14·7 to 15·5; 14·2 to 14·75, and 13·0 inches respectively. Ceylonese examples, again, give a length of 13·5 to 15·0 inches. There is, in fact, a regular gradation from the Australian, Chinese, and Indian races to the birds inhabiting the cooler districts above-mentioned, the large examples found occasionally in tropical localities being either local birds, abnormal in size, or wanderers from contiguous cool countries. As regards Tasmanian examples, the measurements of the wing, supplied to me by Mr. Carr, are 13·75 to 14·0 inches, which correspond with those of the smaller races noticed above.

The White Egret ranges from South Africa, along both coasts of the continent to the North, bordering on the Delta of the Nile. It is tolerably common in Russia, and Central and Southern Europe, breeding in the great marshes of Hungary. In France and Spain, however, it is rare, and appears to be absent from Portugal, though found farther west in the Azores. To Great Britain it is a straggler. Coming now to Asia, we find it common in Asia Minor, and occurring in Persia, whence it ranges through Central and Highland Asia, and along the great Chinese rivers to the coast, and thence to the island of Formosa, where Swinhoe procured it. Southwards it extends into India, Ceylon, and the islands of the Bay of Bengal, passing down the Malay Peninsula, and ranging through the islands of Malayana to Australia. In the latter continent it appears in Dr. Ramsay's "Distribution List," as very widely scattered round the coasts of all the colonies, and it extends inland to Riverina, though this author does not record it from the far interior.

The second species under notice, *Ardea pacifica*, Latham, appears to have visited the island in a small flock during the autumn, and then spread over the northern districts. Mr. Carr informs me that it was recently shot at the Lake River, on the Tamar, and at Stanley, within the space of a day or two. On the 24th ult. I procured an adult female on my own estate at Cullenswood. It was frequenting some temporary rain pools in a paddock not far from the house, and was very shy, but by stalking it in long grass I managed to get a shot and procured it.

The Pacific Heron is a handsome species, with great expanse of wing for the size of its body, which gives it a heavy, flopping flight. The measurements and description of my specimens are as follow:—Length, 30·0 inches; wing, 15·75; tail, 5·25; tarsus, 5·0; middle toe, 2·75; bill, tip to gape, 4·4. It is mottled greenish slate; orbitar skin, dusky bluish; upper mandible and sides of lower, black; base beneath, fleshy whitish; legs and feet, black.

Back wings and tail, dark green, glossed on the outer webs, and tinged with ashy on the shorter scapular feathers; the inner webs of the longer scapular, and a longitudinal patch on each side of the chest, maroon; head, entire neck and throat, white; marked everywhere, but on the chin and throat with cinereous grey; down the centre of the foreneck a stripe of interupted black spots; breast and under surface, dark slate; the feathers with a broad, neesial white stripe, widest on the under tail coverts; a broad, white patch over the point of the wing, extending along the edge to the base of the outer primaries.

This Heron is distributed widely around the Australian Continent, being found on the extreme north coast, though not recorded from the opposite shores of New Guinea, while on the east and south coasts it is an inhabitant of each colony, likewise extending to Western Australia. Although an occasional visitor to Tasmania, so far as past observation shows, it may, perhaps, become more frequent if not molested on its summer visits to us. It is not at all uncommon in the swamps on the Murray and the plains of Riverina.

ADDITIONS TO TASMANIAN FLORA, II.

[BY L. RODWAY.]

Before the year closes I should like to place on record sundry additions to the known plants of Tasmania, found in the vicinity of George's Bay by Mr. Wm. Fitzgerald. They have been verified by Baron von Müeller.

Claytonia pygmœa, F. v. M. This plant is about the size and general habit of its near relation, the common Tasmanian C. calyptrata, from which it can be at once distinguished by its less elongated inflorescence and larger sepals. Subsequent to flowering the sepals close over the capsule, completely burying it between their thick, fleshy masses.

Hydrocotyle capillaris, F. v. M. As small and somewhat resembling H. tripartita (R. Br.), only the leaves are not so deeply divided; usually divided half way to the petiole into three entire lobes. The fruit is very distinct; the intermediate ribs are prominent, and the space between them and the dorsal rib is filled with a spongy-pitted formation.

Schœnus turbinatus, Poiret. This very distinct sedge has, up to the present, only been found in one or two situations, by Fitzgerald. Its occurrence in N.S. Wales led to the suspicion that it had been introduced, but its distance from cultivation, together with the subsequent discovery in the same district of Corysanthes bicalcarata and Schœnus brevifolius, both also natives of New South Wales, considerably raises its claim to be indigenous. The inflorescence of this plant differs from other Tasmanian members of the genus by being collected in tolerably dense beads. In general appearance it approaches Carpha alpina more than any other of our sedges.

Schœnus brevifolius, R. Br. A tall sedge, with almost the habit of a Restio, the specimens found by Fitzgerald often attaining 3ft. The inflorescence is in long, loose, interupted panicles, often 6 or 8in. long.

Gahnia fitzgeraldi. Plant densely cœspitose; stems numerous from a creeping rhizome, about 2ft. high, slender, terete; outer leaves reduced to scarious sheathing scales; inner ones as long as, or shorter than, the stem, with sharply involute margins, and long, subulate points, gradually passing into the bracts subtending the branches of the panicle; panicle 8in. to 12in. long, interrupted branches arising few together from distant bracts, unequal, usually elongated and erect, bearing the spikelets freely distant from one another, the whole panicle having a linear appearanee, but sometimes they are short and contracted, the spikelets then forming small, distant, rather dense heads; spikelets numerous, dark-brown, about 1½ lines long, more or less pedicelled, each subtended by a narrow, aristate bract; outer empty glumes, about four, slightly scabrous on the margin and mid-rib, more or less mucronate, seldom having a much elongated point; flowers, two, the outer one male, the inner hermaphrodite, and an empty glume developed above the flower; stamens, usually three, but in vigorous male flowers, four; style branches, three; nut, about ¾ to 1 line long, ovoid-oblong, dark, not differing in any detail from the nut of G. trifida, and, like it, finely reticulated; filaments partially deciduous, not supporting the nut as in allied species, the bases only remaining.

This plant has a similar, though smaller, habit to Gahnia trifida, Lab., but it has a very dissimilar inflorescence, and distinctly differently constructed spikelets, that species bearing a solitary terminal hermaphrodite flower. I submitted the plant to Baron von Müeller, he considered it new to science, but was too busy at the time to give it the attention required. Subsequently, Mr. Fitzgerald had occasion to correspond with F. Turner, F.L.S., of Sydney, who was not disposed to consider it specifically distinct. Since that I have made an exhaustive examination of a great number of specimens, and, with Baron von Müeller's sanction, and under our joint authority, I have described it as above.

THE USE OF THE WOMERAH, OR "THROW STICK" BY THE ABORIGINES OF TASMANIA.

[By Alfred J. Taylor, F.L.S.]

In the course of a discussion that followed a lecture I delivered recently on the Aboriginies of Tasmania, Mr. Thomas Lewis, a member of this Society, referred to the use of the "Womerah," or "Throw Stick" by our natives. This was the first time I had heard of the instrument being used by the aborigines of Tasmania. There is no record of their use of it in any of the works dealing with their history, nor is the Womerah preserved in any of our Ethnological Collections of Tasmanian Weapons, etc. On the contrary, Ronald Gunn, F.R.S., informed Mr. R. Brough Smythe, who has duly recorded the statement in his account of the aborigines of Tasmania, that "they had no throwing sticks."

The fact related to me by Mr. Lewis, that the natives of this island used the Womerah; that they knew it by that name, and that he himself saw them using it when Robinson brought in the remnants of the race after the celebrated "black war," about the year 1835, is interesting in more ways than one.

It is interesting to know that it was used by our natives at all, and it is interesting to know that it was known by the same name as it is known by among the Goulburn tribe of natives in Victoria. The latter fact may help us in unravelling the mystery of the origin of our aborigines as a race—other tribes calling the instrument by a different name.

The Womerah used by the Victorian blacks is usually a mere stick, with a hook or projection at one end, which the hollow at the end of the spears used fits on to. The object of the Womerah is to give length to the natural arm, and so gain additional leverage power for casting the spear, which, by its aid, could be thrown more swiftly, and to a greater distance.

I was at first inclined to think that perhaps the natives of Tasmania had been taught the use of the Womerah by the native "Mosquito," who came over from New South Wales to Tasmania in the early days of the Colony; but Mr. Morton tells me that there is no hollow in the end of the spears he has in the Museum, showing that for such spears, at least, a Womerah, similar to that made by the natives of other tribes, had not been used.

This, however, presents no difficulty, as Mr. Lewis tells me that instead of having a hook at the end, the Womerah used by the natives of Tasmania had a projection at one end that was hollowed out, and into which hollow the end of the spear was fixed. Perhaps others who read these notes may be able to throw some light on the subject.

CONCERNING VARIOUS MEANS OF ENCOURAGING THE STUDY OF NATURAL HISTORY IN TASMANIA.

[By James R. McClymont, M.A.]

When consulting, recently, the British Museum Catalogue of Lizards, I found that about eighteen species or varieties were attributed to Tasmania, whereas only about five species are admitted by local authorities. This impressed on me the fact which I had previously seen stated, that our natural history collections are, in some respects, still very incomplete. Possibly some of the British Museum specimens of lizards are wrongly allocated, but, allowing for errors in this direction, it would still appear that the collection of Tasmanian lizards in London is more complete than any in Tasmania. However, I quote the instance as typical, not as exceptional. The same is true of the Mollusca. "Nearly half," says Mr. R. M. Johnston, "of the number of the principal type species (of shells) are deposited in foreign museums, and are therefore inaccessible for purposes of reference to local students" (R. S. Tas. Proc., 1890, p. 57).

I am afraid the dispersal of these specimens shows that very little patriotic interest is taken in this matter, and I purpose, briefly, to enquire how such an interest can be awakened and sustained. I shall deal with three only of the most evident means to this end.

(1) The establishment of district museums.

(2) The compilation of cheap scientific manuals, having special reference to the natural history of Tasmania.

(3) The establishment of a lectureship in biology in connection with the Tasmanian University.

(1) My idea of a district museum is a local depository of specimens of the fauna and flora of some well-defined geographical area, such as a group of islands, or a peninsula, or a portion of coast to a given distance inland, or a table-land, or a mountain chain. From a strictly scientific standpoint, such an area would be limited by the homogeneity of its flora or fauna, or by the individuality of its geological features. But as one object of local museums in a new country would be to discover such boundaries, not to ratify them; the definition of a museum area must, in the first instance, result from convenience and practicability.

If we had Field Naturalists Clubs in Tasmania there would be no difficulty about opening local museums. These clubs make it part of their work to form collections of natural objects, and we can imagine what healthy rivalry must be created between clubs in different districts, each striving to excel in the completeness and orderliness of its little local collection. But these clubs do not exist with us, although efforts have been made to establish them, and, though desirable, it is not absolutely necessary to have them before we can hope to open a few local museums, There are many amateur collections of shells, eggs, and other natural objects aimlessly and almost uselessly acquired and maintained; there are many lovers of natural history scattered through the country districts without any definite end in their studies, without specimens to throw life into their reading, without that cohesiveness and unity of purpose which co-operative collecting for a local museum would impart. To both these classes I appeal; to the former, to unselfishly contribute their unclassified private collections to form public and classified ones; to the latter to contribute their time and knowledge for the purpose of inaugurating and arranging collections for their district. I appeal to the well-to-do landowners of the colony for the necessary means. Those of them—possibly there are no exceptions—who are deeply interested in the spread of sound knowledge amongst the people, who are interested in the advance of the colony as a whole, who would joyfully see Tasmania stand up and *do* something—to those I appeal for aid to procure the necessary buildings and fittings. Many of them could spare a room or a renovated outbuilding; many of them could, at little cost, supply shelves or tables to be converted into cases for specimens; all of them could contribute their pence and their moral support.

But it is to the lovers of natural history in the country districts, who with that love combine a fair knowledge at least of the elements of some one branch of natural science, that I look in the first place for support. They would have to take the initiative in their own particular districts, to air the proposal, to interview the amateur collector and soften his heart, to enlist the sympathy of the all-powerful man of substance to set the whole machinery in motion.

At the outset the founders of the local museums would be encountered by serious difficulties in the matter of preserving specimens. Suppose a small building be provided and drawers or cases procured, how are the specimens to be preserved from decay, and from insect pests? As regards the herbarium, some useful directions are given by Mr. Spicer in his "Handbook of the Plants of Tasmania." I would urgently impress upon the Royal Society the utility of publishing directions for the preservation of skins, insects, and reptiles, and regarding the best method of capturing and killing insects. A leaflet would contain all that is necessary, and I am sure the Society would be amply repaid the trifling expense and trouble involved in the preparation of it by the addition to our scientific knowledge that would result therefrom. Let this be the Royal Society's contribution towards the project.

Local museums would educate in many ways, about which I will not expatiate, as I desire to be brief and pointed. Labels would have to be prepared similar to those in use in the Tasmanian museum; but for those who had time and inclination to pursue natural history studies there would have to be more advanced guides in the shape of hand-books to the various branches, compiled with special reference to Tasmania.

(2) There is but a small demand, at present, for such hand-books, but still there is a demand; local museums, I believe, would be the means of greatly increasing it. And I have the more confidence in proposing the hand-books, because somethings of the kind has been already adumbrated in respect of Birds by Col. Legge, Molluscs by Mr. Johnston, Ferns by Mr. Morton. These works, if not intended to assume exactly the form of hand-books, would at least be conducive to their preparation. In some departments, no doubt, our existing information is not complete enough to justify the dogmatism of a text-book. It would be much more complete if we had local collections open to our scientists for purposes of comparison; but there are other departments—those I have mentioned for example—in which we are advanced enough to speak with authority.

(3) Finally, as the cope-stone of the edifice, I would suggest a lectureship in biology in connection with the Tasmanian University. When one reflects that a brief three years ago a university was an unsuspected privilege, it may seem somewhat bold even to hint at a natural history chair in connection with it. I could, perhaps, point with some forcibleness to the example of other colonies; I could mention a Tate, a McCoy, a Hutton, and ask whether the advantages, which have accrued to South Australia, Victoria, and New Zealand from the labours of these indefatigable men of science, might not reasonably be expected to accrue to Tasmania from the labours of one of their compeers. But I refrain, being confronted with the inevitable question of the means thereto. Moreover, the Council of the University have, no doubt, their own ideas as to the fittest allocation of their funds, and the possibility of adding another lectureship to those already established. This much I may be permitted to hope, that they will duly consider the claims of biology to be represented on their teaching staff, and remember the fact that their energy and success in biological investigations have done as much as anything to establish the thoroughness, the originality, and the entire reasonableness of colonial universities in the eyes of the educated world.

ON THE CLASSIFICATORY POSITION AND SYNONYMS OF EATONIELLA RUFILABRIS.

[BY PROFESSOR RALPH TATE, F.L.S., F.G.S., COR. MEMB.]

The subject of this communication, which has long been known as *Bithynia,* or *Tatea huonensis,* though another specific name has priority of fourteen years, has hitherto been handed about from genus to genus without finding a resting place. For some years past I have been convinced of the incompatability of its reference to those families under which it has been placed; its location under Rissoininæ was the first step which led me to its present classificatory position in the genus *Eatoniella.*

The main portion of this essay was written twelve years ago, but the desire to fully work out the anatomical characters has always been my plea for postponement of publication; now, however, the opportunity of addressing the conchologists of Tasmania, who have most materially contributed to the bibliography of the species, cannot be resisted, though further study in the direction indicated is still very desirable.

The shell was first made known by A. Adams in 1862 (unless *Amnicola badia,* Gould, is the same) from specimens collected on the shore at Port Lincoln, in South Australia, and named by him, *Diala rufilabris.* E. A. Smith, in 1875, pointed out that it differed essentially from *Diala,* by its thickened and continuous peristome, and oblique aperture and columella, and removed it to the genus *Hydrobia.*

Tenison-Woods, in 1875, described the same shell as *Bythinia huonensis.* In 1878 R. M. Johnston transferred it to *Bithynella,* and Tenison-Woods in the same year, from information concerning the animal which I had supplied, did me the honour to erect for it the genus *Tatea,* which has done service till now. Unfortunately, Tenison-Woods mis-read my notes on the animal, and partially made amends in the following year; the chief error in his description relates to the operculum, which is not calcareous, though it is somewhat strengthened on the inner face with calcareous matter. In this way Tryon, 1883, came to be mislead, and placed *Tatea* in the family Rissoellidæ; this is repeated by the same author in 1887, and is followed by Fischer, in his "Manuel de Conch." of the same year.

In the meanwhile, E. A. Smith, in 1882, proved the identity of *Diala rufilabris* and *Tatea huonensis* by comparison of Adams' type with authentic examples from Tasmania, and quotes the species as *Tatea rufilabris.* Up to this time the shell had remained unfigured, and it has subsequently been illustrated by Tryon in 1887, and Petterd in 1889. No further information of the animal has been published than that given by Tenison-Woods at the two references under *Tatea huonensis.*

On the publication of the anatomical characters of the animal of *Dardania* (Hutton) a new genus of Rissoinæ, in Trans. New Zealand Institute, 1882, I could not fail to recognise in it a congener with *Tatea rufilabris.* Both Tryon and Fischer place *Dardania* and *Tatea* as subgenera under *Jeffreysia.* Further investigations by Hutton (Proc Lin. Soc., N.S. Wales, vol. ix., p. 940, 1885) have lead him to consider *Dardania* synonymic with *Eatonia* (E. A. Smith), changed by Dall to *Eatoniella,* because Smith's name was preoccupied. In all essential characters *Dardania olivacea* and *Tatea rufilabris* agree with *Eatoniella* ; however, they are not of the same species, differing much in the shape of the shell, and in the outline of the foot.

My observations on the animal of Eatoniella rufilabris, are as follow :—*Foot,* when extended, between two and three times as long as broad, truncated and auricled in front, somewhat narrowed in the ante-medial region, expanded and rounded posteriorly ; *muzzle,* reddish-brown, with a colourless tip; *tentacles,* long, subulate, colourless, but encircled with brown near the tips; *operculum,* pancisperal, thick, externally corneous, somewhat calcareous on inner face, provided with a vertical submarginal claw, which is denticulated on its edge. The animal resembles that of *Amnicola,* as represented by Stimpson ("Researches upon the *Hydrobiinæ,*" p. 84) ; but the opercular characters do not belong to that family as defined by him, and are those proper to *Rissoininæ.*

Tatea is not synonymous with *Gabbia* (Tryon) as has been suggested by some conchologists. An examination of examples of the species, *G. australis* from its type-locality, proves that the surmise of Stimpson that the shell is a *Bythinia,* is correct, and justifies Brazier's interpretation of the generic characters, he having independently described the same as *Bithynia hyalina*; in our conjoint "Check List of the Freshwater Shells of Australia" it stands as *B. australis* (Tryon, sp.)

Eatoniella rufilabris occurs at South Grafton, Clarence River, N.S. Wales, and has been identified by E. A. Smith from specimens received from Brazier. Examples of the same have been determined by Tryon to be *Amnicola badia* (Gould), originally known from Banks Peninsula, New Zealand. However, the researches of Prof. Hutton on the New Zealand Hydrobiinæ, in N.Z. Inst., 1882, p. 143, plate i., show that *Melania corolla* is a *Potamopyrgus,* the operculum of which has no internal process. I think we must vote Tryon in the wrong, more especially as the shells of the two species, *Eatoniella rufilabris* and *Potamopyrgus badia,* have much resemblance to each other; however, it must be admitted that Hutton has not shown that *Amnicola badia* (Gould) is a *Potamopyrgus,* though he has for *M. corolla,* which he regards as the same species.

Eatoniella is known by three species, inhabiting Kerguelen Island, one New Zealand, and one Australia.

The *habitats* of the last are as follow:—Usually on submerged weeds, or sheltering under stones at the margin in water-courses subject to tidal influences, though occasionally in fresh water, but rarely in waters wholly saline. It is a characteristic estuarine shell, but is present in some inland brackish waters; is abundant throughout Southern Australia and Tasmania, and extends to the Clarence River in New South Wales.

The following references supply the chronological history of the species:—

FAMILY RISSOININÆ.

GENUS EATONIELLA.

Eatonia, E. A. Smith, 1875 (*now* Hall, 1857).

Eatoniella, Dall, 1876 (*nom. mut.*).

Tatea, Tenison-Woods, 1879.

Dardania, Hutton, 1882.

EATONIELLA RUFILABRIS.

1863.—*Diala rufilabris,* A. Adams, Ann. Mag. Nat. Hist., p. 298.

1865.—*Diala rufilabris,* Angas, Proc. Zool. Soc., p. 174.

1875.—*Hydrobia rufilabris,* E. A. Smith, P.Z.S., p. 538.

1876.—*Bythinia huonensis,* Tenison-Woods, Roy. Soc. Tasmania for 1875, p. 77.

1878.—*Bythinia huonensis,* Tenison-Woods, Roy. Soc. Victoria, vol. xiv., p. 62.

1879.—*Bithynia huonensis,* Petterd, Journ. Conch., vol. ii., p. 93.

1879.—*Bithynella huonensis,* R. M. Johnston, Roy. Soc. Tasmania for 1878, p. 28.

1879.—*Tatea huonensis*, Tenison-Woods, Roy. Soc. Tas- Tasmania for 1878, p. 71.

1880.—*Tatea huonensis*, Tenison-Woods, op. cit. for 1879, p. 72.

1881.—*Tatea huonensis*, Tate and Brazier, Proc. Lin. Soc., N.S. Wales, vol. vi., p. 564.

1882.—*Tatea rufilabris*, E. A. Smith, Proc. Lin. Soc., London, vol. xvi., p. 268, tab. 7, fig. 19.

1883.—*Tatea huonensis*, Tryon, Syst. Conch., vol. ii., p. 259.

1887.—*Jeffreysia (Tatea) huonensis*, Tryon, Man. Conch., vol. ix., p. 397, tab. 60, fig. 94.

1889.—*Tatea rufilabris*, Petterd, Roy. Soc. Tasmania for 1888, tab. 2, fig. 1, p. 78.

1889.—*Tatea rufilabris*, Brazier, Jour. Conch., p. 72.

NOTES ON SOME PLANTS NEW TO TASMANIA.

[By Leonard Rodway.]

Pomaderris elachophylla, F. v. M. A small leaved shrubby species of Dogwood. The infloresence is looser and more interrupted than in most plants of the genus. It had hitherto only been recorded from Victoria. Last September I found a patch of it growing near Longley, on the road towards Kingston.

Corysanthes bicalcarata, R. Br. This plant somewhat resembles C. fimbriata, but is easily recognised by its very different labial petal, and the leaf being red-brown beneath instead of primrose. I believe it had not been found south of the northern districts of N.S. Wales till lately, when it was discovered near the Scamander, and also at George's Bay, by Mr. Wm. Fitzgerald.

Pterostylis concinna, R. Br. This orchid, like P. nana, and P. prœcox, is delicately pubescent on the scape. It is easily recognised from its nearest allies by the labellum being rather shorter than the column, of equal breadth throughout, and broadly bifid at the apex. It is at present flowing freely on the heathy country between Bellerive and Beltana, and is, no doubt, common in many parts throughout the island, but overlooked. In the same locality P. prœcox was flowering. Together with these I found an orchid of an intermediate type. Instead of the basal rosette of leaves of P. concinna, or the leafless but bract-bearing scape of P. prœcox, it was between the two possessing true petisled leaves, but they were inserted on the scape, the lowest being the largest. With this intermediate type of foliage, there was an intermediate type of labellum ; that organ was longer than that of P. concinna, and less so than P. prœcox, and at the same time it tapered towards the apex, as in the latter, but was bifid, thereby approaching the former. After making a copy of this interesting plant, I sent it to Baron von Müeller, but, unfortunately, the material was too meagre for him to come to any decision. For my part, I think lengthy observation will reveal many varieties between these two species, and possibly, also, between them and P. nana.

Chorizandra cymbaria, R. Br. This sedge was discovered some months ago, near Reminé, by Mr. Wm. Fitzgerald. Its principal home is W. Australia, but it has also been sparsely formed in N.S. Wales, Queensland, and once in Gippsland.

Gahnia rodwayi, F. v. M. This sedge is new to science, and was named after its finder, by Baron von Müeller. It is very common on hills from the fourth milestone on the Huon road to Mt. Nelson. It grows in dense, grassy clumps amongst the under shrubs. Its inflorescence is buried deep in the stems and leaves. Stock are particularly fond of it, and keep it eaten close down, except where protected.

Lepidosperma inops, F. v. M. Another sedge new to science. I have found it in quantity on the hill to the left of the new reservoir, Hobart, and no doubt it is common elsewhere. In general appearance it somewhat resembles L. lineare, but is smaller, and the spihelets, which are always few in number, are on very short stems, and are protected by long leafy bracts. It also seems a favourite with stock in the poor country it prefers, and the density of its growth, and its tenacity among the rocks, make it of some value as a fodder plant.

These last two, together with two more not yet named, and found by Mr. Wm. Fitzgerald in the neighbourhood of George's Bay, are at present in Baron von Müeller's hands, awaiting his leisure to be scientifically described.

ON NEW SPECIES OF TASMANIAN ARANEÆ.

By A. T. Urquhart, Corr. Mem. Royal Society
of Tasmania.

Fam. THERAPHOSIDÆ.

Gen. Macrothele, Auss.

Macrothele aculeata, sp. nov.

Mas.—Ceph. th., long, 7; broad, 5·1. Abd., long, 6; broad, 3·7; legs, 1, 4, 2, 3=24, 23, 22, 20 mm.

Cephalothorax, brownish-ochreous, median band dark chestnut-brown, trisected, central stripe and basal third of lateral attenuated; latter pair rapidly dilated, encroach over ocular region without any very determinate limits; thoracic indentation and marginal zone dusky; hairs black, short, sparse; lateral margins armed with a fringe of somewhat equidistant black spinelike bristles; two short oblique rows of similar bristles occur on posterior incline; ovate, rounded, and very slightly compressed beyond coxæ of first pair of legs; pars cephalica roundly truncated, convex, depressed visibly behind ocular elevation: *clypeus* projecting, height about equal to diameter and a-half of a fore-central eye; pars thoracica depressed by convex; indentation transverse, deep; caput and radial striæ broad, and somewhat shallow; profile, contour inclined gradually backwards, occiput arched.

Anterior row of *eyes* procurved, laterals close to margin of clypeus; central-pair posited on summit of elevation, less than their radius apart, separated from side-eyes of same row, which are oval, and nearly one-third larger, by an interval perceptibly shorter than their own diameter; posterior pairs in two sub-contiguous groups, median-eyes opalescent, much the smallest of eight, fully their breadth from anterior centrals; laterals oval, exceed hind-median pair by one-third, directed somewhat backwards, divided from fore-centre pair by a space surpassing their length.

Falces lake-brown; fairly-well haired on second half; linear, conical, project forwards at an angle of 20 deg.; profile arched; as long as the tarsus of second leg, not as stout as tibial joint.

Maxillæ orange-ochreous; inversely conical, similar in form to coxal joints of first pair of legs, inclined at same angle, palpi inserted at truncated extremity.

Labium brownish orange; small, about as wide as long; apex rounded.

Sturnum deep ochraceous; hairs black, coarse, moderately thick; ovate, lip at apex.

Legs, femora, patellæ and tibiæ olive-brown, longitudinally marked with brown-ochreous stripes, latter devoid of hair; outer lateral stripe broadest of series; streaks on tibiæ of fourth legs somewhat undetermined; metatarsi and tarsi brownish ochreous, base suffused with red-chestnut; legs stout, femora compressed; tibiæ cylindrical; pars tibialis of fore-leg projects from distal fourth-inner side, two stout, lake-brown, black-tipped processes, directed towards each other; articulated extremity of front process cloven; posterior process stoutest, projects two sub-processes, upper—longest and strongest, somewhat spiral; lower—acuminate, apex reaches second half of upper sub-process, projects a long bristle; tarsi of first and second pairs somewhat turgid; scopula fine; femoral joints armed with bristle-like spines on superior aspect; tibiæ of two first pairs have 1, 1, 1, 2 beneath; metatarsus of first leg row of 3 at fore-end; of second 1, 2, 1, 3; tarsus of latter 1, 1, 1, small spines on inner side; spine armature of hind-pairs, including tarsi, more numerous and irregular. Superior tarsal claws—first pair, well curved, free end long; outer claw has 1 short basal tooth, 3 long, 4 moderately long open teeth; inner has only 7 teeth, being short of 1 medium tooth; inferior claw short, no teeth.

Palpi brown-ochreous, somewhat striped with olive-brown; humeral joint and lamina tinged with olive-green; stout; pars humeralis moderately compressed, in length fully equal to two-thirds of cubital and radial joints together; armed on superior aspect with row of spines; pars cubitalis cup-shape, more than half-length of penultimate article; latter joint cylindrical, truncated and somewhat constricted at extremity; projects from central third-outer side, a strong curved process furnished with numerous short, stout, black spines. Lamina strongly convex; somewhat quadrilateral, quite one-fourth longer than wide, inner margin impressed; superior fore-angle conical, prolonged forwards. Genital bulb connected to anterior end of lamina by a short stalk; viewed from inner side, lake-brown; discoid, prolonged into a long, flattish, sub-spiral, tapering apophysis, projecting backwards beyond the medial process, lake-brown above, pale brown-ochreous beneath; superior face of bulbous brownish-ochreous, discloses, apparently, two large, lake-brown, convex lobes; upper, or lobe proper, broad-pyriform; lower lobe sub-elliptical, formed by the tumid margin of bulbous.

Abdomen ovate, base truncated; rugose; fairly well furnished with black hairs, and stiff coarse bristles; light brown, passing into brownish-ochreous, beneath; dorsal aspect suffused with a fuscous-brown; series of ten large spots of the lighter brown shade, enclose an oval area occupying the posterior three-fourths.

Single example.

FAM. DRASSIDÆ.

Gen. LAMPONA, Thor.

Lampona sub-aquila, sp. nov.

Fem.—Ceph. th., long, 3·8; broad, 2·8; facial index, 1·2. Abd., long, 4·3; broad, 2·8; legs, 1—4, 2, 3=8, 6·5, 6 mm.

Cephalothorax dull lake-black; hairs fine, light brown, tolerably sparse; rugose; oval, slightly compressed beyond coxæ of first pair; cephalic part convex, truncation sensibly rounded, marked with a shallow medial groove; *clypeus* visibly shorter than breadth of a fore-centre eye; thoracic part convex, indentation longitudinal; profile-line slopes gradually backwards with a slight double arch.

Eyes from two procurved rows; posterior line rather the longest; centrals oval, visibly less than their diameter apart; nearly twice their length from laterals, which they sensibly exceed in size; median pair of anterior row surpass side-eyes in size by nearly one-third; dark, separated from each other by rather more than an eye's radius, about half that space from laterals of same row, which are removed from margin of clypeus by an interval equalling their own radius; side-eyes have the pearl-grey lustre of posterior centrals.

Falces lake-brown; transversely rugose; conical, somewhat divergent, directed forwards, base projects beyond plane of clypeus; length equal to digital joint of palpus; their space visibly surpasses breadth of hind row of eyes.

Maxillæ yellowish-mahogany; long, sub-linear, increasing gradually in breadth, obtusely truncated, inclined against lip; base free, pointed,

Labium lake-brown, passing into a yellowish mahogany colour; twice as long as wide, conical, apex abscinded, extends nearly to base of the truncated inferior angle of maxillæ; organ rugose.

Sturnum crimson-brown; studded with small papillæ projecting hairs; acute oval, fore end rather sharply constricted above coxæ of first pair.

Legs, two first pairs glossy, brownish-yellow; hind pairs lighter shade; have indications of dusky annuli on all joints except tarsal; moderately stout; tolerably well-furnished with light hairs; scopula moderately developed, extends to base of metatarsus; claw tuft projects beyond claws, which are stout, short, well-curved; about 4 open teeth.

Palpi yellowish-amber colour; fairly well armed with hairs; pars humiralis compressed, perceptibly longer than cubital and radial joints together; pars cubitalis cup-shape, shorter than penultimate and digital joints, which are of about equal length.

Abdomen elongate-oviform, base truncated, stalk exposed; somewhat thickly clothed with short, light-yellowish hairs; ground colour light olive-brown; posterior-third clouded with fuscous-green; elongate, light olive-green mark on central third; ventral region shade lighter than dorsal; rather thickly clothed light-brown hairs, grouped in open tufts, arranged somewhat in lines. *Corpus vulvæ* represents a large, sub-hexagonal, moderately elevated, areolated area, centre purple-chestnut, passing into amber-brown; inferior half occupied by a large, deep, sub-circular fovea, whose hind-margin is developed into a single scolopi; fore-margin interrupted by a reddish, black bordered, wide, linear-oval groove, which curves over the more tumid, superior half of corpus, terminating above the rima genitalis.

Single example, Launceston.

Gen. DRASSUS, Walck.

Drassus pellus, sp. nov.

Fem.—Ceph. th., long, 4·9; broad, 3; facial ind., 2·5. Abd., long, 5; broad, 3; legs, 1, 4, 2, 3=14·3, 12, 11, 9·7 mm.

Cephalothorax light burnt amber, greenish tone, facial area, striæ and marginal zone darker shade; fairly well clothed with a light pubescence, erect black hairs on caput; oval, moderately constricted beyond coxal joints of first legs; cephalic region dilated forwards, truncation visibly rounded, convex; *clypeus* in height fully equals breadth of a fore-centre eye; thoracic part convex, sides impressed above marginal zone; normal grooves shallow; profile-line dips at an angle of 50 deg. to thoracic junction from limit of caput, ascends somewhat shapely over cephalic region, which is rather prominently rounded on fore-part.

Posterior row of *eyes* somewhat strongly procurved, centrals visibly smaller than laterals of same row, removed rather further from them than they are from each other; anterior row slightly recurved, median-pair sensibly larger than lateral eyes, separated by an interval nearly equal to an eye's diameter, less than their breadth and a half from side eyes, which are placed obliquely on a strong tubercle, divided by a space surpassing the breadth of the hind and somewhat smallest eye.

Falces greenish coffee-brown; hairs bristly, black, transversely rugose; conical, vertical, base turgid, projects beyond plane of clypeus, length equals metatarsus of second leg; stout, space exceeds breadth of ocular area.

Maxillæ light olive-brown, inferior margin streaked with chestnut-brown; armed with coarse erect black hairs; strong, gradually dilated, round pointed, straight.

Labium light olive-brown, clouded with red chestnut; conical; apex emarginate, three-fourths length of maxillæ.

Sturnum olive-brown; hairs whitish and black; ovate.

Legs light raw-sienna; armature, hairs whitish and black, latter most numerous, 4 or 5 rather slight; black spines on superior aspect of femora; patellæ project a bristle; tibial joints of first pairs, 8 slender spines on inferior surface; tibiæ of hind pairs, 5; metatarsal joints have about 12, including distal ring; scopula moderate, claw-tuft slight.

Palpi brownish-yellow, pars digitalis red-chestnut; moderately slender; furnished with black and light hairs; spines bristle-like, long and strong on digital joint.

Abdomen elongate-ovate; rather light olive-brown, pattern ill-defined—apparently a wide chocolate-brown stripe on basal half, double row of spots, similar shade, on posterior half. *Corpus vulvæ* brownish dark, chrome-yellow; posited on a large, somewhat triangular, elevation; rather more than half of the posterior side is occupied by a large, deep, trapizoidal pit, widest in front, posterior side, which exceeds the lateral in length, produced into a broad)(shaped septum; lateral and fore-margins prominent, beaded, centre-third of fore-margins produced into a lip-like projection representing a segment of a circle; curving round from angles of cavity towards the lip are two brown tipped, pointed, membranous processes, margins subclosed above; base of corpus turgid, wide and rounded in front, divided beneath lip by a broad, somewhat impressed, greenish-brown area.

Single specimen.

Drassus brunneolus, sp. nov.

Mas.—Ceph. th., long, 6; wide, 4·5; facial index, 3·1. Abd., long, 7; wide, 4·5; legs, 1, 2, 4, 3=23·5, 18·7, 17·5, 15 mm.

Cephalothorax fuscous; hairs light-yellow, adpressed, moderately thick, few black on caput; oval, constricted beyond coxæ of first pair; pars cephalica convex, lateral margins moderately arcuated, frontal margin sensibly rounded; depth of *clypeus* fully equals diameter of a fore-centre eye; pars thoracica convex, groove longitudinal; radial and caput striæ

—when wet—well defined; profile line represents a low arch on forepart of caput, descends gradually to limit of thoracic indentation, from thence dips rather abruptly to stalk.

Posterior row of *eyes* rather strongly procurved; median-pair sensibly surpass laterals in size, removed about one-fourth further from them than they are from each other; anterior row moderately recurved; centrals more than twice as large as hind pair, fully their radius from each other, separated by twice that interval from side-eyes of same row, which are oval; laterals posited obliquely on a tolerably strong common tubercular prominence, divided by a space nearly equalling breadth of posterior eye, which is about one-third smaller than anterior eye.

Falces lake-black; hairs yellowish and black, moderately long and thick; transversely rugose; conical, inclined very perceptibly forwards, base projects beyond plane of clypeus; somewhat turgid and grooved on inner side; length equals the pars tibialis of a third leg; about as stout as the femur of the second.

Maxillæ dilated forwards, round-pointed, slightly inclined towards *labium*, latter conical, abscinded, two-thirds length of maxillæ; organs dark chocolate-brown, apices brownish-yellow.

Sturnum greenish coffee-brown; oval.

Legs, thighs orange-brown, first pair tinged with lake; patellæ, tibiæ — metatarsi reddish-orange, more or less—especially two anterior pairs, tinged with lake-brown; strong; fairly-well furnished with longish black hairs; femoral joints have 8 or 9 spines; tibiæ of I.—II., 10 spines, of III.—IV., about 8; metatarsi of first and second legs have respectively 7—8; hind pairs about twelve; scopula and claw-tuft tolerably strong.

Palpi, humeral joint brownish-orange, of somewhat even breadth, barely surpasses cubital and radial together in length; pars cubitalis colour of former article, somewhat campanulate, equals penultimate joint in length, projects moderately strong bristles; radial joint lake-chestnut, armed with stout bristles, rather stronger than the pars cubitalis; obliquely truncated from apex of fore-process; superior angle projects three strong processes, directed forwards; centre process stoutest and longest, extends over base of clava; lateral processes form a line above central; inferior angle produced into an obtuse-conical process. Lamina lake-chestnut, well furnished with light hairs and long bristles; narrow ovate. Base of genital bulb represents a yellowish-brown, striated, sub-crescentic lobe, of somewhat even breadth; remity of outer horn membraneous, ovate, dilated, visible surface concave; projecting from within concavity is a short, yellowish process; inner horn turgid, projecting, sharply recurved, and developed into a rich mahogany-brown, continuous membrane, which covers superior aspect of bulbous, its prominently arcuated margin fitting closely to the crescentic lobe; anterior fourth free, tapering, curves outwards and backwards.

Abdomen elongate-oviform; light olive-brown; markings purple-brown, ill-defined; basal-half exhibits an acute-elliptical figure, bordered with a deeper shade; posterior-half marked with about five pairs of spots; indications of oblique striped en lateral margins; ventral region purple-brown, defined by light hairs; shield elongate, yellowish-brown, bordered with light hairs. Abdomen clothed, rather thickly, with light yellowish and erect brown hairs.

Single specimen.

Gen. CLUBIONA, Str.

Clubiona elaphines, sp. nov.

Mas.—Ceph. th., long, 6; wide, 4·1; facial ind., 3·1. Abd., long, 6·5; wide, 4; legs, 4, 1—2, 3=16, 15, 11·5 mm.

Cephalothorax brownish-orange, passing into lake-chestnut on cephalic part; moderately clothed with fine, adpressed, pale yellowish and black, bristle-like hairs, sub parallel, lateral compression at caput slight.

Posterior and anterior rows of *eyes* sensibly and equally procurved; hind row of about equal size; centre-pair visibly the most distant apart; median eyes of front row more than twice size of hind pair, two-thirds their breadth apart; fore-laterals exceed hind pair by one-third, interval dividing them is fully equal to one-half the space separating the anterior pair from centrals of same row.

Falces brownish-orange, lake-reflections; few hairs; rugulose; sub-conical, anterior-fourth somewhat constricted, project much beyond plane of clypeus, inclined farwards, divergent.

Maxillæ light red-chestnut; long, bent outwards, second-half dilated, superior—external angle obliquely truncated; inferior angle acutely truncated.

Labium and maxillæ concolorous; rather more than twice as long as wide, sub-parallel, roundly emarginate.

Sturnum brownish-yellow; ovate; eminences opposite coxæ.

Legs shade lighter than cephalothorax, metatarsal and tarsal joints of I.—II. deeper tone; armature, fine, adpressed, pale yellowish, and erect black dairs; spines black.

Palpi colour of legs; short, slender; humeral joint incrassated forwards; spine armature I., III. on fore-third; cubital joint sub-linear, more than one-third length of former article, projects a moderate bristle; radial joint about half length of cubital, produced on outer side into a strong, flattish, clathrate, blackish-lake process, directed forwards, upcurved, equal to article in length; pars digitalis, lamina oval, fairly haired, few bristles; bulb sienna-brown, few vein-like, dark brown lines; regulose; elongate, moderately tumid, posterior end cleft; covered by a dusky, wrinkled, membrane on inner side; fore-half—rather more—longitudinally intersected by a deep groove; extremity of bulbous concave, deeply emarginate; inner lobe, which extends nearly to apex of lamina, drawn out into a wide tapering spiral, bright orange-red apophysis, lying across extremity of bulb; outer lobe produced into two processes, upper simi-pellucid, conical; plainly visible immediately beneath it is a broad, rounded, black process, contiguous to a pale pyriform lobe.

Abdomen ovate, moderately convex; tolerably well clothed with fine light-yellow and erect black hairs; yellowish stone-colour, markings blackish-violet; on basal-third is an elongate figure of no determinate form, followed by a series of about seven, sub-touching, broad lanceolate marks, decreasing in size to anus; directed inwards from lateral borders are several large tooth-like projections.

Fem.—Ceph. th., long, 7; wide, 4·9. Abd., long, 8·5; wide, 4·9; legs, 4, 1—2, 3=18, 16, 13 mm.

Cephalothorax shade darker than males, visibly more dilated.

Eyes do not differ essentially from males.

Falces brownish-lake; transversely rugose; conical, gibbous at base in front, project moderately.

Maxillæ and *lip* lake-brown; normal form.

Sturnum brownish-orange, brown spots opposite coxæ.

Legs, in colour and armature resemble males. Femora of first and second legs have I. I., II. slender spines, of hind pairs, I., I., III.; patellæ of III.—IV. one side-spine; tibiæ of I. II., 2, 2 beneath; of III—IV., 7 somewhat irregular spines; metatarsi of I. II. have 2 basal; of III.—IV., have respectively 6—8; distal rings of 6 spines.

Palpi colour and armature of legs.

Abdomen in form, colouration, and specific pattern does not differ essentially from the male. *Corpus vulvæ* sub-circular, inferior-half moderately elevated, transversely wrinkled, light reddish-brown, fuscous stains; centre of superior-half occupied by a large, yellowish, circular fovea intersected by a pale, somewhat Y shaped costa, border colouration of upper-half, somewhat membraneous, broad, ridged, constricted in front at base of costa; dark fore-margin projects over the rima genitalis.

Four specimens, Domain, Hobart.

Clubiona apiata, sp. nov.

Fem.—Ceph. th., long, 3·4; wide, 2·5; facial index, 2. Abd., long, 6; wide, 3·2; legs, 1, 4, 2, 3=16·3, 12, 11, 7 mm.

Cephalothorax light ochreous-brown; cephalic region exhibits medial and lateral bands lightly tinted with olive-green, former dilated, tapers to fovea, broken at limit of caput by a chestnut-brown lanceolate figure; latter bands interrupted; sparingly clothed with a pale pubescence and darkish hairs; nearly as long as the patellary and tibial joints of second leg; pars cephalica depressedly convex, sides abrupt; height of *clypeus* less than diameter of a fore-centre eye; thoracic part low, fovea very shallow; profile-contour inclined backwards with a visible curve to thoracic indentation, from thence dips to stalk more abruptly.

Eyes on narrow dark rings; posterior row sensibly procurved; median-pair scarcely larger than laterals, a little more distant from them than they are from each other; anterior row slightly recurved, centrals visibly exceed hind-pair in size, form with them a trapezoid narrowest in front; posited rather closer to one another than they are to side-eyes; latter pair separated by an interval equal to about three-fourths their diameter.

Falces ochraceous, faint olive-green streak; haired; sub-conical, fore-third somewhat constricted and divergent; project forwards; length rather surpasses their space, latter interval exceeds breadth of hind-row of eyes.

Maxillæ shade darker than legs; moderately haired; second-half dilated; superior external angle prominent, less acutely truncated than inferior angle, base of which nearly reaches lip.

Labium light brown; length rather exceeds breadth; sides rounded; apex abscinded; nearly two-thirds length of maxillæ.

Sturnum colour of coxæ; faint olive-green, triangular marks between the slight eminences.

Legs slender; shade lighter than cephalothorax, tinged at articulation of joints with red-lake; hairs fine, sparse; few slender black spines on femoral, tibial, and metatarsal joints; spines on penultimate article strongest; claw-tuft moderately developed; scopula somewhat scant; hairs fine.

Palpi paler than legs; hairs short, fine; slender; length, 4 mm.

Abdomen oviform, elongate; ground colour olive-green, closely spotted with stone-coloured, lake-tinted, lobate flecks; dorsum stained with lake, exhibits on posterior-third a brown-pink, linear lanceolate figure, which throws off a series of fine, dark-lake coloured lines, converging above the yellowish spinners; lateral margins and ventral region free from lake stains; fairly well clothed with short, whitish hairs. *Corpus vulvæ* represents a hemispherical elevation, truncated in line with the rima genitalis, concave within; of a pale ochreous-brown, clouded with olive-green.

Single example.

Fam. THERIDIIDÆ.

Gen. LINYPHIA, Latr.

Linyphia melanozantha, sp. nov.

Mas.—Ceph. th., long, 3; broad, 2·2. Abd., long, 3; broad, 2·2. Legs, 1—4, 2, 3=9, 8, 6·7 mm.

Cephalothorax rich ochreous-orange, lake reflections; marginal zone, ocular area, and wide stripe on clypeus olive-green; very sparsely furnished with black hairs; rugulose; broad-ovate, slightly compressed forward; pars cephalica semi-oval, convex, eye eminence prominent; three very perceptible medial grooves on occiput; *clypeus* projecting, height less than two-thirds depth of facial space; pars thoracica sub-circular, moderately convex, centrally depressed; indentation somewhat T-shape; caput and radial striæ fairly well marked; profile-contour gradually inclined backward, sensibly arched over occiput; thoracic curve more prominent.

Posterior row of *eyes* sensibly recurved; median pair about one-third smaller than side-eyes, posited obliquely, separated by an interval fully equal to the breadth of an eye; removed from laterals by twice that space; anterior row recurved; centrals dark, less than one-half size of hind pair, occupy a somewhat shorter space, rather more distant from side-eyes than they are from each other; latter pair large, have the pearl-grey lustre of posterior centrals seated obliquely on a common black tubercular prominence, sub-touching.

Falces olive-brown; transversely rugulose; somewhat slender, linear-conical, extremities bent a little outwards; retreating base level with plane of clypeus; length equal to depth of facial space.

Maxillæ ochreous-orange, fore-third suffused with olive-green, rather longer than wide, obtusely pointed, inclined over *labium*; latter organ reddish-brown; broad oval.

Sturnum ochreous-orange, brown margins; triangular, broad.

Legs yellowish-orange; femora and tibiæ of two first pairs almost entirely suffused with blackish-olive; metatarsi and tarsi have a dusky hue; indications of annuli at base of penultimate articles; tibiæ of third and fourth legs have irregular evanescent rings at base; moderately clothed with strongish, black hairs; tibial and metatarsal joints armed with black bristle-like spines; superior tarsal claws; first pair strong, somewhat evenly curved; two close basal teeth; eight curved, open teeth; inferior claw sharply bent; two teeth, outer strongest.

Palpi yellow-orange; stout; pars humeralis nearly as long as clava, incrassated forwards; cubital joint—viewed from above linear—roundly pointed, narrower than humeral joint, projects two black bristles; pars radialis quite as long as former article, laterally compressed; projects from above a very remarkable large, fuscous, bifurcating process, base and branches flat; leading branch about as wide as stem, gradually and moderately dilated forwards; apex truncated, incurved; lateral branch shortest, projects at a right angle towards clava, orbicular-spathulate; base of process armed with strong, long, black bristles; lamina fuscous-olive, moderately furnished with coarse, black hairs; rugose elongate-ovate; base obtusely truncated, upturned above into a short, pointed process; genital bulb represents a somewhat oblate-spheriod, basal end crossed by a transverse, olive-green callus forepart, traversed by a brown-lake callus; these bands are divided by a wide, yellowish groove, exhibiting beneath a dark sub-callus; the turgid anterior aspect of bulb is drawn out into a very wide, greenish membrane, reaching to apex of clava.

Abdomen inversely ovate; blue-black; spinners brownish-yellow; hairs black, coarse, somewhat sparse.

Fem.—Ceph. th., long, 2·2; wide, 2. Abd., long, 3·2; wide, 2·3. *Masc.* Ceph. th., long, 2·6; wide, 2·3. Abd., long, 4; wide, 3. Legs, 1-4, 2, 3=7, 6, 5·3 mm.

Cephalothorax glossy, deep amber colour; ocular area and clypeus suffused with olive-green; marginal streak dark, sparingly furnished with coarse, black hairs; rugulose; pars cephalica convex, semi-oval; eye eminence prominent; lateral index about equal to facial; *clypeus* inclined forwards, height, less than two-thirds depth of facial space; pars thoracica circular, moderately convex; posterior incline depressed; radial striæ well defined, caput grooves less pronounced; profile-line dips from limit of caput to thoracic junction at an angle of 30 deg., ascends moderately, with a sensible curve, to hind-row of eyes.

Posterior row of *eyes* sensibly recurved, nearly straight; centre-pair fully one-third smaller than laterals, rather more distant from them than they are from each other, an interval slightly exceeding their own diameter; anterior row recurved; median pair dark, about one-half size of hind-centrals, form with them a trapezoid, the front line of which is shortest; visibly more remote from one another than they are from side-eyes; laterals of fair size, have the pearly lustre of posterior centre-eyes posited obliquely on a strong, common tubercle, sub-contiguous.

Falces yellow-brown, olive-green hue; fore-half and sides suffused with a deeper shade; linear-conical, retreat perceptibly; not fully as stout as the femur of a second leg, as long as the pars digitalis of palpus.

Maxillæ brownish-yellow, mottled, fore-half passing into olive-brown; well developed, somewhat linear, round-pointed; inclined over *labium*; latter organ shade darker; breadth surpasses length by one-third, somewhat rounded.

Sturnum deep chestnut-brown; glossy; broad-cordate.

Legs orange-ochreous; first pair, basal two-thirds of femora olive-green; tibiæ suffused with same shade; metatarsi and tarsi slightly suffused, faint basal ring on former articles; markings on second legs resemble first, except that the broad bands on femora are reduced to basal annulations; third and fourth pairs have very faint indications of annuli; hairs black, somewhat coarse and sparse; few bristle-like spines. Superior tarsal claws—first pair, 15 open comb-teeth forming an even line with point of claw; inferior claw sharply bent, two tolerably strong teeth, outer longest.

Palpi, colour and armature of legs; pars digitalis fuscous-green; rather longer than cephalothorax; palpal claw moderately curved, 11 open comb-teeth extending length of claw.

Abdomen broad-ovate, projects over base of cephalothorax; bluish-black; sparingly clothed with coarse black hairs. *corpus vulvæ* yellowish mahogany colour, fuscus clouds about base; represents a large transverse, sub-oval, plano-convex, turgid projection; superior margin somewhat prominent, projects over the rima genitalis.

Numerous examples differing somewhat in their cephalic shading and leg markings.

Linyphia quindecim-punctata, sp. nov.

Fem.—Ceph. th., long, 2·1; wide, 1·5. Abd., long, 4 wide, 2. Legs, 1, 2, 4, 3=10·6, 10, 9, 7 mm.

Cephalothorax ochreous-brown; dorsal aspect of caput dark chocolate; sides of thorax clouded and streaked with olive-

of tolerable and near
posterior row sensibly procurv
distant from laterals than they
terval scarcely equalling an e
recurved; centrals dark; sma
one another by more than an
diameter from side pair; latera
pair in size, posited obliquely o
ately strong tubercular elevation,

Falces brownish-ochreous, clou
conical, divergent, retreating; ba
plane of clypeus; three strong teet
small, moderately stout; length
digitalis of palpus.

Maxillæ ochraceous, base chocol
broad, inclined towards one another

Labium greenish-chocolate, apex
apex tumid, everted.

Sturnum olive-green; cordate near

Legs slender, ochreous-yellow, an
femoral, tibial, and metatarsal joint
rings, III.—IV. pairs two; hairs 1
patellæ, and tibæ moderately armed w

Palpi and legs concolorous, long, slen
joints project strongish bristles.

Abdomen elongate-oviform; ground
folium ovate, occupies dorsal aspect, fle
along margins, with lake-tinted
plays round bor

is a yellow translucent, very slender stylus, apex ladle-shape; springs from base of sub-scape.

Single example.

Linyphia sub-luteæ, sp. nov.

Fem.—Ceph. th., long, 2·1; wide, 1·6. Abd., long, 3·2; wide, 3. Legs, 1, 4, 2, 3=12·8, 8·6, 8, 6 mm.

Cephalothorax, light ochreous-brown; medial streak wide, without clearly defined limits, chocolate-brown; lateral margins speckled with similar tone; broad-ovate, slightly compressed at caput; pars cephalica convex, roundly truncated; eye prominence moderate; height of *clypeus* rather exceeds one-half depth of facial space; pars thoracica prominently convex; fovea deep elongate-oval, longitudinal; radial striæ fairly well marked; caput grooves well defined; profile line rises with a sensible curve from margin of eye area to limit of caput, from thence represents an abrupt curve to stalk.

Eyes on black rings, enclose an oval space; centrals of posterior row removed rather further from laterals than they are from each other, an interval fully equal to an eye's breadth; median-pair of anterior row dark, scarcely as large as hind pair, form with them a sub-quadrilateral figure, rather longer than broad; divided from side eyes by a space equalling their radius; laterals visibly the smallest of eight, opalescent; posited on a moderate sized, common dark tubercle, sub-touching.

Falces, yellowish, amber colour; slender, conical; inclined forwards, base in line with plane of clypeus; length equal to depth of facial space.

Maxillæ ochreous-brown; long, linear-spathulate; somewhat bent over lip.

Labium, lightly suffused with olive-green; short, about twice as wide as long, rounded, everted.

Sternum, pale brownish-olive, metallic reflections; heart-shape; slight eminences opposite coxæ.

Legs, light ochreous-brown; central and distal annulations of a deeper tone on tibæ and metatarsi; hairs dusky, tolerably thick; bristle-like spines on the pars petellaris and tibialis.

Palpi, colour and armature of legs; cubital joint shorter than radial; digital rather longer than humeral.

Abdomen oviform, projects well over base of cephalothorax; hairs yellowish, short, fairly thick; ground colour light brown, approximating to olive-green; central-third occupied an elongate, diamond-shaped figure, stained with dark margins pale brownish-chrome.

Single specimen.

Lin

Fem.—Ceph. th., lo
broad, 2. Legs, 1, 2, 4,

Cephalothorax fulvou
and radii olive-green, la
a similar tint. Hairs s
at caput slight; pars ce
truncated, lateral index
clypeus vertical, depth sca
centre eye; pars thoracic
normal grooves fairly pe
from stalk at an angle o
perceptible curve.

Posterior row of *eye*
equidistant, centrals nearl
same row, separated by sca
their diameter a half fr
dark, moderately recurved,
other; median pair rather
rings, divided by an interva
eyes posited obliquely on d
radius of the fore-eye apart,
between the hind-lateral an

Falces brownish-amber co
base in front, vertical; leng
rather stouter than thigh of

Maxillæ greenish-yellow, d
as broad as long, rounded
interval

sparse, spines bristle-like, 1 or 2 on femora of I—II; patellæ project 1; tibiæ 2 or 3; metatarsi less; superior tarsal claws —1st pair, long, slender, slightly curved, about 18 short, close teeth; inferior claw sharply bent, 1 long tooth.

Palpi pale-brown, radial joint greenish; armed with bristles; palpal claw long, slender, somewhat straight, tip bent, 6 short open teeth.

Abdomen oviform, depressedly convex, greenish gamboge, more or less stained with reddish-lake, spotted with silver lobate specks—few golden, more or less confluent along margin of dorsal band; latter broad at posterior end, tapers forward to a mere streak, displays two cross-bars on basal curves; broader part exhibits 6 or 7 ill-defined arcuate-bars; the indigo-brown colour of ventral region encroaches in a wedge-shape into lateral margins from posterior end; shield sub-oval, border light brown, silvery flecks. *Corpus vulvæ* represents a dark brown, sub-circular elevation; each lateral slope indented by a small, shallow, ovate fovea, whose apex is directed inwards; fovea connected by a strong, dark, V-shaped costa, whose extremity reaches over the edge of the somewhat abrupt incline above the rima genitalis.

Two examples.

Gen. THERIDIUM, Walck.

Theridium pilatum, sp. nov.

Mas.—Ceph. th., long, 2; wide, 1·5. Abd., long, 2·2; wide, 1·7; legs, 1, 2, 4, 3= 12, 8·2, 7·5, 4·9 mm.

Cephalothorax brownish-stone, passing into ochreous-orange about facial region, speckled with olive-brown; median band dilated on caput, mottled with olive-brown; hairs very sparse; ovate, lateral compression slight; cephalix part convex, round-pointed; height of *clypeus* equal to rather less than one-half depth of facial space; thoracic region convex, fovea sub-oval, deep; caput and radial striæ moderately defined; profile-contour represents a double arch; thoracic curve which rises sensibly above plane of caput, dips abruptly; cephalic part forwardly inclined.

Eyes on dark rings, of moderate and nearly equal size; posterior row procurved, centrals divided by nearly an eye's interval, removed one-fourth more than that space from side-eyes; anterior row recurved, median pair dark, largest of eight, separated from one another by scarcely more than an eye's diameter, and from side-eyes by an interval sensibly less than their radius; laterals smallest of eight, seated obliquely on a common, lake-brown tubercle, sub-touching.

Falces ochreous-orange; slender, conical, vertical, length equal to breadth of ocular area.

[illegible]
femora of I.—II. ; distal
of first pair 4 rings, of hi
metatarsal joints have ce
cated. Hairs somewhat
tibial joints.

Palpi humeral cubital j
mate article and clava ochr
what stout, exceeds in len
third ; cubital somewhat ca
enlarged and roundly pointe
articles furnished with bla
tapering, directed towards ea
strong, black hairs ; genital l
side, mitriform ; inferior side
oval, shield-like callus ; projec
extending nearly to extremity
apophysis, sub-spiral, abrup
shortly prolonged, cyathiform.

Abdomen oviform ; hairs spa
large and small creamy-colour
a lanceolate figure, somewhat
with large fuscous spots ; mar
posterior incline exhibits a sub-
normal flecks ; lateral margi
interrupted fuscous band, gr
curves round spinners, conflue

Fem.—Ceph. th., long, 2 ;
wide, 2·8. Legs, 1, 2, 4, 3=1

Cephalothorax brownish ston
constricted at fove
somew

Falces colour of cephalothorax; conical, inclined sensibly forwards; base scarcely projects beyond plane of clypeus; in length fully equal to the pars digitalis of palpus.

Maxillæ normal stone-colour, two fore-thirds suffused with a deeper shade; as long as falces.

Labium light olive-green; oval, length rather surpassed by width.

Sternum greenish stone-colour, wide olive-brown border; broad cordate, perceptible eminences opposite coxæ.

Legs, slender; light brownish stone-colour; femoral, tibial and metatarsal joints have more or less undefined olive-brown distal and pre-apical annulations; sparingly armed with dusky hairs; patellæ and tibiæ of two first pairs have respectively 1—2 slender bristles.

Palpi shade paler than legs; slender; few hairs and bristles.

Abdomen sub-ovate, base rather prominent, grooved; ground colour approximating to brown-pink, passing into a pale tone beyond folium, numerous small stone-coloured flecks and dark brown spots; rather more than half of dorsum occupied by a lanceolate figure—apex directed backwards, spotted—especially the haft, which about equals the lance-head in length, with fuscous dots, margins creamy, stained with orange-red about lance-head; lateral margins have three interrupted fuscous, nearly vertical, bands, first band terminates in a large spot on posterior side of stigmata, interspace occupied by creamy flecks; three spots occur close to spinners, centre brown, oblong; outer spots consist of a group of light flecks. *Corpus vulvæ* greenish stone-colour; represents a moderately prominent sub-triangular elevation, whose extremities curve over the orange-brown stigmata; comprised within the shallow, somewhat oval, central depression are two not very clearly defined sub-circular fovea divided by a broad septum, about their equal in diameter; projecting from within each fovea are two processes, forming a transverse line; outer pair black, cylindrical, short; inner pair perceptibly the widest, brownish-lake, linear spathulate, concave on fore-side, fully four times as long as outer processes.

Two males and a female.

Fam. ENYOIDÆ.

Gen. Habronestes, L. Koch.

Habronestes flavipedes, sp. nov.

Fem.—Ceph. th., long, 3·6; wide, 2·5. Abd., long, 4·5; wide, 2. Legs, 4, 1, 2, 3=11, 10, 9·9, 9 mm.

somewhat abruptly from
moderately rounded ; ca
shallow ; contour of profil
angle of 45 deg., represent
by two slight arches, cro
plane of occiput.

Eyes in two procurved r
circular ; eyes equal in size
from laterals than they ar
scarcely equalling their own
procurved, median pair one-t
divided by a space equal to a
third smaller than centrals of
by an interval less than half t
of hind-row by fully one-half

Falces dull lake-brown, con
inferior margin of fore-third
conical, anterior kind (rather m
arched.

Maxillæ chestnut-brown, in
as wide as long, of somewhat e
towards each other, divided b
breadth of lip.

Labium fuscous, margin a
abscinded, everted, less than h

Sturnum dark brown-lake ;

Legs bright yellowish-oran
brown ; femoral, tibial and m
almost entirely suffused
do not

Abdomen oviform, base roundly truncated, second half dilated, pointed; dull fuscous-black; thickly studded with small papillæ; hairs black, sparse; ventral region light olive-brown. *Vulva* reddish-brown, clouded with a deeper tone; triangular-obovate, moderately elevated; transversely rugose; superior half occupied by two large sub-pyriform foveæ, divided by a wide rapidly dilated septum, bordered by bead-like costæ; shows two mussel-shaped indentations, contiguous to costæ.

Single specimen.

FAM. TETRAGNATHINÆ.

Gen. TETRAGNATHA, Latr.

Tetragnatha quadri-notata, sp. nov.

Fem.—Ceph. th., long, 3·5; wide, 2·4. Abd., long, 5·2.; wide, 3·5. Legs, 1, 2, 4, 3=19·3, 13, 11, 8 mm.

Cephalothorax fulvous, ocular area lake coloured; dorsal band dappled with olive-brown, lake vein-like streaks; bi-crenate, fore-half much the widest, ends abruptly at fovea; encloses four large subpyriform, fulvous spots, first pair encroach between dorsal and lateral eyes; sub-marginal band coloration of median. Some examples exhibit olive-brown stripes in radiating depressions; very sparingly furnished with hairs; pars cephalica depressedly convex, sides steep, roundly truncated, eye-prominence moderately developed; facial index exceeds lateral by one-fourth; transverse sub-oval fovea in centre; pars thoracica broad ovate, rises above plane of caput, posterior incline depressed; fovea elliptical, longitudinal, deep; normal grooves somewhat shallow; profile-line ascends at an angle of 30deg. from dorsal eyes to limit of caput, dips rather more abruptly to thoracic junction.

Eyes of moderate and nearly equal size; posterior row slightly procurved; centrals less than one-third larger than laterals, separated by an interval exceeding an eye's radius, removed from side eyes by their breadth; anterior row recurved; median pair visibly smaller than laterals, rather further from each other than they are from the latter pair—an interval sensibly surpassing their breadth; lateral eyes posited on a strong, common, dark tubercle, sub-touching.

Falces yellowish mahogany; sub-conical, base projects beyond plane of clypeus; fore-third divergent, plainly longer than the pars digitalis of palpus, fully as stout as the femur of a fore-leg, retreat sensibly.

Maxillæ ochreous-brown, pale apices; spathulate, superior angle rather prominent, inclined towards each other.

Labium darker shade; sub-oval, everted, nearly as long as wide, about half length of maxillæ.

Sturnum mahogany-brown; cordate, eminences opposite coxæ.

Legs fulvous, conspicuously spotted with light olive-brown and lake dots, latter predominate, annuli, olive-brown; suffused with dark-lake; markings vary somewhat in individual examples; fairly well furnished with outstanding, black hairs; all joints, except tarsi, tolerably well armed with yellowish, dark-tipped, slender spines. Superior tarsal claws —1st pair, evenly curved, 12 close teeth; inferior claw, sharply bent, free end directed forwards, 2 close teeth.

Palpi light fulvous, radial and digital joints ringed; palpal claw long, 7 teeth.

Abdomen oviform; light fulvous, posterior three-fourths of dorsal aspect more or less suffused with lake, flecked with rather large and small lake-coloured dots; larger spots have a dense shade; basal end somewhat unspotted; folium extends from about second quarter to anus, posterior two-thirds reddish-lake, marginal spots resolved into sinuate border; flecks on petiole intermixed with black-lake streaks and dots; spots on ventral region resolved more or less into longitudinal streaks; light ground colour encroaches from base dividing the wide quadrate median stripe from vulva and sides; spinners light purple. *Corpus vulvæ* red-chestnut; elevated, represents the segment of a circle, centre-third somewhat rounded, tumid, projects forwards, discloses beneath a moderately wide, dark bordered, sub-linear septum, intersecting two large mussel-shaped foveæ.

Several examples.

FAM. EPEIRIDÆ.

Gen. EPEIRA, Walck.

Epeira phalerata, sp. nov.

Fem.—Ceph. th., long, 3; wide, 2·5; facial index 1. **Abd.** long, 6; wide, 4. Legs, 1, 2, 4, 3=3·2, 7·4, 7·8, 5·5 mm.

Cephalothorax light olive-brown, speckled, especially about normal grooves, with olive-green; wide median and submarginal bands tinted with olive-green; eye-eminence reddish-brown; hairs white, silky, tolerably long and thick; cephalic part moderately convex, ocular eminence prominent; lateral index one-third shorter than facial; height of *clypeus* just surpasses interval of a fore-centre eye; thoracic part moderately convex, sides well rounded; posterior incline occupied by a trisected area, apex emarginate, limited by thoracic indentation; caput and radial striæ somewhat shallow; profile contour represents an even arch, fore and hind slope about equally steep.

Eyes do not differ greatly in size, posterior centrals intermediate between anterior median pair and laterals; hind row moderately recurved; centre pair posited somewhat obliquely, divided by nearly an eye's breadth, about their space and a quarter from side eyes; anterior row strongly recurved; centrals separated from each other by less than their diameter and a half, perceptibly more than that interval from hind pair, rather less than their space from laterals; latter pair seated obliquely on low eminences, scarcely their radius apart.

Falces coloration of cephalothorax, basal half mottled; linear conical, gibbous in front, vertical, stout, in length fully equal to digital joints of palpus.

Maxillæ breadth somewhat surpassed by length, enlarged and prominently rounded forwards, inclined over *labium*, which is rather wider than long, round-pointed; organs dark chocolate-brown, apices fulvous.

Sturnum indigo-chocolate; broad-cordate, eminences opposite coxæ.

Legs light yellow-brown; femora marked with three wide annulations, lake-chocolate on fore-pairs; approximating to olive-brown, and interrupted on hind-pairs; patellary joints of third and fourth legs show two rings, first greenish; tibiæ two annuli, basal narrow, brown; anterior rings olive-brown, breadth more than half length of article; central and distal annulations of a greenish colour on metatarsi; anterior half of tarsi olive-brown; somewhat sparingly furnished with light hairs; spines yellowish, slender, moderately numerous; two first and two hind-pairs of about equal strength; thighs dilated, compressed; patellæ-tibiæ of I.—II. stout, latter cylindrical.

Palpi light yellow-brown, olive-brown annulations at base of humeral joints, and at extremities of cubital-radial; two fore-thirds of digital joints olive-brown; armature, light hairs, black spines.

Abdomen oviform, base pointed, somewhat aplanate above, projects well over base of cephalothorax; humeral tubercles depressedly conical; posterior pair transverse, low, rounded; hairs, white, short, thinly interspersed; dorsal region cream-colour, lightly clouded with olive-brown; closely speckled with small testaceous spots; dorsal band wide, basal fourth yellowish, mottled with brown, bounded by a testaceous line, uni-dentate; dentations encroach over, the otherwise cream-coloured tubercles; longitudinally interrupted by a wide, creamy, red bordered stripe, exhibiting a brown and red medial mark; dorsal band somewhat compressed from humeral tubercles, widely dentate; fore-third of constricted part, speckled, cream colour, displays an olive-brown medial stripe, traversed by three streaks; posterior two-thirds yellowish-olive, mottled with olive-green; three small impressed dots arranged in a recurved line occur on verge of anterior slope; five pairs of blue-black impressed spots on constricted part of band; two fore-pairs most pronounced, form a trapezoid narrowest in front, on the cream-coloured area; lateral margins gamboge colour, speckled with the normal red dots; inferior half mottled with olive-brown, displaying a somewhat acute-crenate outline; fore-part of ventral aspect occupied by a brown, semi-circular patch, bordered on outer side with yellow; posterior part fuscous. *Corpus vulvæ* black-brown; represents a projecting, triangular, transversely rugulose, aplanate scape, more than twice as broad as long, margins wide, revolute, increasing in breadth at apex; superior margin of corpus developed into a rather wide membraneous costa, curving somewhat over the rima gentitalis, centrally depressed.

Single example.

Epeira obscurta, sp. nov.

Fem. ceph. th., long, 2·7; broad, 2; facial index, 1·5. Abd. long, 5; broad, 4. Legs, 1, 2, 4. 3=10, 9, 8, ·3, 6 mm.

Cephalothorax lake colour; hairs white, tolerably long and sparse; pars cephalica convex, roundly truncated, eye-prominence tolerably strong; facial index exceeds lateral by one-third; mamiform elevations moderately developed; *clypeus* perceptibly surpasses diameter of a fore-centre eye; pars thoracica somewhat depressed, well rounded; fovea sub-oval; normal grooves rather shallow; contour of profile represents a low arch.

Eyes tolerably small; posterior row straight; median pair posited obliquely on large circular, elevated fuscous spots, divided by an interval equal to twice an eye's breadth and a half, their space and one-third from laterals; anterior row only moderately recurved; centrals sensibly larger than hind pair, a little more distant from them than they are from each other, an interval visibly shorter than the space separating the hind centre eyes; laterals rather smaller than posterior median pair, divided by a space scarcely equalling their radius, seated obliquely on rather low eminences.

Falces light, dull ochreous-brown; hairs fine, whitish; sub-conical, vertical, profile curved, first half prominent, length equal to interspace between anterior lateral eyes; as stout as the pars femoralis of a fore-leg.

Maxillæ fuscous, apicus olive-green; breadth somewhat surpassed by length, obtusely pointed, directed towards each other.

Labium, sub-triangular, rather wider than long, more than half length of maxillæ, similar colour.

Sturnum fuscous; sparingly clothed with white adpressed hairs; cordate, perceptible eminences opposite coxal joints.

Legs brownish-gamboge, femora of two first pairs suffused with red-lake; of third pair central and distal reddish rings; femora of hind legs have anterior three-fourths suffused with lake-brown; indications of annuli on other joints; moderately strong; sparingly armed with whitish hairs and slender yellowish spines.

Palpi colour and armature of legs.

Abdomen broad oviform, depressed, humeral tubercles obtuse-conical, directed outwards and upwards; posterior tubercles obtuse; central of first row rather the longest, much the widest; tubercular projection of second row somewhat surpasses upper tubercle in size; lowest represented by a strong wrinkle; ground colour very pale raw-sienna, orange tinge, lightly suffused—mainly on folium, with a pale olive-brown; speckled with rather faint lake flecks; margins of folium somewhat undetermined, crenate, yellowish-olive; three pairs of impressed spots, fore-pairs form a trapezoid narrowest in front; centre pair largest and darkest; dorsal aspect laterally bordered by interrupted, deep olive-green bands; ventral colouration represents various shades of brown encroaching into lateral margins; *corpus vulvæ* brownish-yellow; sub-quadrate, elevated, deeply emarginate at base of scapus, which is of a light yellow-brown colour, projects nearly one-half its length beyond corpus, transversely wrinkled, aplanate, first half ovate, moderately wide; basal end of second half oval, about half breadth of first part, fore-half compressed, vermiform; corpus laterally margined by reddish-brown, ear-shaped, well-developed costæ, discloses at posterior end of shallow cavity bordered by costæ, two somewhat pyriform lobes.

Single specimen.

Epeira sub-flavida, sp. nov.

Fem.—Ceph. th., long, 4; broad, 3; facial index, 1·8. Abd., long, 8; broad, 6. Legs, 1, 2, 4, 3=12, 11·4, 11, 9 mm.

Cephalothorax deep fulvous, slightly speckled with chestnut-brown; eye prominence yellow; sub-parallel streaks on caput exhibit two spots; fovea dark; radii of thorax shaded with the normal rich chestnut; hairs yellowish, sparse; fore-half of cephalic part somewhat depressed above, squarely truncated,

side e
inctly recurved ; central
than hind pair, rather mc
exceeding an eye's diamet
less than their space from
hind centrals in size, posi
apart.

Falces light fulvous, su
few white hairs ; conical,
anterior row of eyes ; stout

Maxillæ fulvous, shaded
wide at fore-end, pointed,
organ has a deeper tone tha
oval.

Sturnum deep fulvous, sp
nut-brown ; cordate.

Legs yellowish, perceptible
with brown ; light olive-bro
femora ; patellæ colour of an
tibial and metatarsal joints
yellowish, short ; spines yell
numerous ; tibial spines less
length ; legs of tolerable stren
length.

Palpi fulvous ; fore-end of
armature light hairs and spines

Abdomen triangular-ovate, bas
mamiform, project upwards a
dorsal slope terminates with a
pointed tubercle ; inferior tu
obtusely pointed ; groun

pale, dark-centred fovea, most pronounced on lateral margins; ventral aspect fulvous, speckled, approximating to olive-brown about sides, which display several vertical pale olive-green lines. *Corpus vulvæ* represent a large triangular, longitudinally depressed scape, lying close to abdomen, apex directed towards sturnum; exhibits seven distinct yellowish stone-coloured wrinkles—the extremity, which was somewhat damaged, apparently terminates with three black, and several less pronounced reddish wrinkles; base of scapus roundly emarginate, project a brownish, gradually dilated septum, which curves round the incised margin of corpus; latter represent two olive-brown lobes—bordering the rima genitalis, surpassing in length, but otherwise not differing essentially from wrinkles of scapus.

Single specimen.

Gen. ARACHNURA, Vinson.

Arachnura trilobata, Urq.

Described and figured in the "Transactions of the New Zealand Institute." Vol. xvii. p. 37.

Average length of *female* about 9 mm., *male*, 5 mm.

Cephalothorax glossy black; prominently sculptured. *Legs* moderately long, rather slight; pale greenish-yellow, annulations broad, olive-black. *Abdomen* oval, moderately wide, convex, terminates posteriorly in three blunt, transversely wrinkled protuberances; centre-process much the longest and stoutest, flexible; glossy brown-black, median band tolerably wide, silvery, stained with lake, extends to base of tail-like process; cross-bar and apex of latter organ reflect the normal metallic lustre.

A female example of this handsome species was contained in *Mr. Morton's* collection. This species is not very uncommon in New Zealand; varies somewhat in the colouration of the legs and specific pattern.

Gen. ÆREA, Urq.

Ærea magnifica, sp. nov.

Mas.—Ceph. th., long, 2·5; broad, 2; facial index, 1·8. Abd., long, 3; broad, 2·8. Legs, 1, 2, 4, 3=7·3, 6·8, 6, 4 mm.

Cephalothorax ochraceous, green tinge; cephalic region suffused with purple-lake; thoracic groove, lateral borders of caput, and thorax stained with lake-purple; studded with papillæ, the larger grouped somewhat in lines; hairs dull silvery and deep golden, somewhat sparse; sub-aplanate, sides tolerably abrupt, base prominently rounded, lateral compression at caput moderate; frontal angles stout, trapezoidal, directed forwards and outwards, about as long as broad in front; *clypeus* pointed, retreating, depth fully equal to space occupied by anterior centre-eyes; thoracic indentation subcruciform, shallow; radial striæ faint; caput grooves more defined; profile line slopes back from dorsal eyes at an angle of 30 deg. beyond first half, base rounded; dips more abruptly across eye region.

Posterior row of *eyes* very strongly procurved; median pair placed obliquely on well-developed, dark-ringed tubercles, which are posited on crown of caput, separated by an interval equalling space occupied by fore-centre eyes; removed from laterals by their space and a quarter, and from anterior median pair, which they equal in size, by scarcely their space; anterior row visibly procurved; median eyes seated on tolerably prominent sub-tubercular eminences, divided by an interval fully as wide as their diameter, plainly more than their space from side eyes; laterals placed less than the radius of a hind eye apart at extremity of frontal projections; fore and hind eyes are respectively the largest and smallest of eight.

Falces brownish, suffused with purple-brown; transversely rugose; sub-conical, retreat rather sharply, base barely in line with plane of clypeus, length about equal to their space.

Maxillæ yellowish-chestnut, apices pale slate; broad-spathulate, inclined towards each other.

Labium shade darker than maxillæ; triangular.

Sturnum brownish-purple, ovate, moderately studded with papillæ, projecting hairs.

Legs, anterior pairs yellowish - chestnut, lake - brown reflections, femora clouded with dark-brown, evanescent, reddish-chestnut annulations on the patellary and tibial joints; posterior pairs yellow-orange, second half of femora occupied by lake-brown rings; tibiæ and metatarsi have interrupted lake-brown basal annulations; two first pairs of nearly equal stoutness, much the strongest; tarsus of first leg rather shorter than metatarsus, somewhat elevate, furnished with close-lying black hairs; armature, light, fine, sparse hairs; light brown, tolerably strong spines; 7 or 8 on femoral joints, including two stout, curved spines on superior aspect of fore-half; patellæ 3; tibiæ and metatarsi of I.—II. about 16 long spines, of IV. respectively 6-10; third pair rather more sparingly spined.

Palpi, ochreous-yellow, wide, broken, fuscous rings on humeral joint; latter article compressed, fore-half incrustated; length equal to the cubital and radial joints together; pars cubitalis oval, projects a moderately strong bristle; pars radialis campanulate, plainly longer and wider than former article, armed with numerous long bristles. Lamina ochreous-yellow, passing posteriorily into lake brown; rather sparingly haired; broad-oval, base developed into a turgid costa, curved sharply forwards; posited immediately in front of basal end of costa, outer side, is a large, conspicuous, lake-black, crescent-shaped, sub-free process. Bulbous genitalis mahogany-brown, reticulated—viewed from front, sub-obovate, fore-third deeply cleft beneath lamina; a moderately long, orange-brown, linear apophysis curves over the somewhat pointed base; most observable appendages beneath bulb are two strong, black close-lying, curved, spine-like apophyses, projecting from outer margin of concavity transversely across bulb.

Abdomen sub-aplanate, sides rugose, base rounded in outline; tapers from humeral tubercles to posterior-third, which is constricted to rather less than half the greater breadth; basal margin studded with a series of six small tubercles, centre pair greenish-yellow, much the largest, visibly more distant from humeral tubercles than they are from each other; humeral tubercles of moderate size, obtusely conical, opalescent, streaked with lake; upper side exhibits a remarkable pearl-like spot; integument developed immediately behind humeral tubercles into sub-tubercular elevations not differing very essentially either in form or colour from the former; projecting from second quarter of dorsal aspect is a large backward curved process, resembling the horn of a rhinoceros—about as wide at base as long; length equal to more than one-fourth of abdomen; orange-ochreous, speckled with red-brown, apex yellow; posterior side exhibits a yellow, white-haired medial stripe, bordered with a dark edge, rising from posterior third is a similar but much smaller process, flanked by two pearl-like spots; hind tubercular projections in two rows; laterals longest, somewhat elongated; directed outwards, lake-brown, pale median streak; centre tubercle much the smallest of the row, obtuse-conical, tubercle of second row pointed, rather wider than long, fully half length of laterals; two centre tubercles yellow, marked with red-lake; ground colour blue-black; the pattern—which resembles the handsome border of an Oriental shawl—is of an orange colour picked out with lake, clothed with golden and silver hairs; basal cross-band occupies one-third of dorsum; fore-half of band exhibits a series of circles enclosing blue spots, separated by about their own diameter; second half represents a centrally interrupted band of somewhat even width, figured with blue and lake sinuate lines; design on posterior two-thirds consists of a series of intricate lines enclosing two unfigured sub-oval patches, which flank the larger process.

Two male specimens.

Fam. THOMISIDÆ.

Sub-Fam. Philodrominæ.

Gen. Philodromus, Wlk.

Philodromus luteo-virescens, sp. nov.

Fem.—Ceph. th., long, 3·5; broad, 3. Abd., long, 5; broad, 3. Legs, 1—2, 4, 3=16, 12·5, 11·5 mm.

Cephalothorax ochreous-yellow—probably tinged with green; facial space ochraceous; rather sparingly furnished with short, yellowish, and black hairs; pars cephalica moderately convex, frontal line sensibly rounded; height of *clypeus* equal to three-fourth diameter of a fore-centre eye; pars thoracica broad-ovate, moderately convex; indentation longitudinal; normal grooves faint; profile line inclined and visibly arched across caput, dips to thoracic junction at an angle of 50 deg.

Posterior row of *eyes* sensibly procurved, equi-distant—centrals slightly surpass laterals in size—posited on rather low, fuscous tubercles, directed somewhat backwards; anterior row perceptibly recurved; centrals fully one-third larger than hind pair, closer to one another—scarcely more than an eye's breadth—than they are to the latter pair; lateral eyes placed on moderate, dark tubercular eminences, divided from each other by an interval nearly equalling their diameter and a half; fore-eyes separated from anterior centrals by scarcely their radius.

Falces light ochreous; conical, vertical, base projects beyond plane of clypeus; space exceeds breadth of hind row of eyes, length equal to about three-fourths of space.

Maxillæ colour of coxæ; gradually dilated, rounded, strongly convex, moderately inclined towards each other.

Labium tinged with green; length surpassed by breadth, rounded.

Sturnum greenish-yellow; broad-cordate.

Legs ochraceous, green tinge; patellary, tibial, and metatarsal joints have lake reflections; metatarsi and tarsi longitudinally streaked with lake-brown; moderately furnished with whitish and black bristle-like hairs; slender bristles and spines on femoral, tibial, and metatarsal joints; tibial spines of first pair one-third length of article. Scopula rather sparse; claw-tuft moderate. Tarsal claws—1st pair, tolerably strong, about 20 somewhat even comb teeth, free end sharply curved.

Palpi paler shade than falces, pars cubitalis tinged with lake. Palpal claw short, well curved; 5 teeth.

Abdomen elongate-oviform; yellowish pea-green; dorsal streak, evanescent posteriorly, moderately wide, defined by somewhat faint yellowish flecks. Hairs sparse, short, whitish and black. On ventral surface is a conspicuous patch of black hairs, flanked by spots of white, visible amongst the hairs is the *vulva*, which represents a simple depressed area occupied by two dark foveæ, intersected by a)(shaped septum.

Single example.

FAM. LYCOSIDÆ.

Gen. LYCOSA, Ltr.

Lycosa albo-pilata, sp. nov.

Mas.—Ceph. th., long, 2·8; wide, 1·8. Abd., long, 3; wide; 1·7. Legs, 4, 1—2, 3=8, 6·5, 6 mm.

Cephalothorax brown-pink, yellowish hue round margins; stretching across thorax are two broad, fuscous bands—outer border sinuated, the deeper fuscus shade encroaches more or less over sides of caput and ocular area; lateral margin dark, narrow; hairs white and orange-yellow, dense, patchy, short, black, and erect on dorsal line; ovate, lateral margins of caput gradually compressed forwards; pars cephalica aplanate, sides abrupt, squarely truncated; *clypeus* in depth scarcely equals interval separating fore-central eyes; pars thoracica elevated, indentation longitudinal; radial striæ well defined; caput grooves shallow; profile line dips abruptly posteriorly, slopes slightly forwards with a visible curve to second row of eyes.

Anterior row of *eyes* moderately procurved; centre pair exceeds side pair by nearly one-third, visibly more than the diameter of an eye apart, less than that interval from laterals; eyes of second row greatly surpass in size that of first line, interspace not equal to an eye's diameter and a half; dorsal pair more than one-half as large as the latter pair, removed fully one-fourth further from each other than they are from eyes of second row.

Falces brownish-yellow, second half clouded with dark olive-green; sub-conical, fore-third divergent, retreat sensibly.

Maxillæ moderately enlarged forwards, sub-elliptical, curve somewhat over *labium*, which is about as wide as long; rounded; organs light yellowish-brown, slightly suffused with olive-green.

Sturnum light yellow-brown, margins stained with brown; ovate.

Legs greenish stone colour, passing into olive-brown towards extremities, brown-pink reflections along superior aspect; three ill-defined olive-green rings on femora, tibiæ, and metarsi; indications of annuli on patellary joints; hairs erect, black, and yellowish; fairly-well armed with spines on femoral, tibial, and metatarsal joints.

Palpi armed with black bristles and white hairs; pars humeralis greenish stone colour, olive-brown basal and apical rings; length fully equal to the two preceding articles, of even breadth, projects two long bristle-like spines on medial line; four short spines form a transverse group on fore-end; cubital joint ochraceous, dusky clouds; viewed from above, elliptical; pars radialis olive hue, clouded, cup shape, quite one-third shorter than former article; digital joint surpasses humeral in length; lamina creamy-ochreous, figured with two interrupted, brownish cross bars; hairs fine, sparse; ovate. Bulbous genitalis brown, turgid behind, membraneous in front, margin drawn to a sharp point on outer side; viewed from beneath, discloses three easily perceptible appendages projecting from within; nearest to basal end is a semi-transparent, membraneous, tapering organ; immediately beyond are two red-brown, dark-bordered, large, sub-linear apophyses of about equal length and breadth; first and inner apophyses stretch across face of bulbous to anterior third of clava, posterior side concave, transversely rugose, margins incurved, apex truncated, fore-angle curved upwards; hind-angle prolonged, bent downwards; outer margin produced about midway into a short, pointed, backward-curved process; front apophysis crosses hind and curves back on posterior side of the above-mentioned process; somewhat aplanate above, convex on inferior side, apex moderately pointed.

Abdomen oblong-ovate; dull, greenish, gamboge colour, moderately spotted and streaked with olive-black; spots on posterior incline resolved into somewhat undetermined arcuate lines; outline of folium evanescent; latter design has a deeper tone than ground colour, sharply constricted at posterior fourth; basal half exhibits a broad triangular mark, dappled with black-brown, encloses a linear-lanceolate figure, thickly clothed with white and ochreous-yellow hairs, latter predominate round margin. Abdomen clothed with short, whitish and yellowish hairs, increaing in length on lateral margins.

Fem.—Ceph. th., long, 3; broad, 2·1. Abd., long, 3·1; broad, 2·1. Legs, 4, 1—2, 3=10, 7·7, 6·7 mm.

Cephalothorax brown-pink; thoracic part displays two broad brown bands—outer border undulating, encloses a tapering dorsal mark; ocular area and sides of caput clouded; tolerably well clothed with white and ochreous-yellow hairs, few black, bristle-like hairs on caput; ovate moderately compressed forwards; facial index surpasses lateral by one-fourth; pars cephalica depressedly convex; sides abrupt; height of *clypeus* exceeds interspace between fore-centre eyes; dorsal aspect of thoracic part aplanate, sides somewhat steep; groove longitudinal; radial striæ tolerably well defined; contour of profile rises from stalk at an angle of 60deg.; slopes visibly across occiput; slightly curved between third and second row of eyes.

Anterior row of *eyes* procurved; median pair sensibly larger than laterals; one-third further from each other than they are from side-eyes—a space about equal to their own diameter; eyes of second row tolerably large, rather more than the breadth of an eye from each other; dorsal pair visibly smaller than eyes of second line, removed about one-third further from one another than they are from latter pair.

Falces brownish-yellow, two fore-thirds suffused with olive-brown; conical, inclined sensibly towards maxillæ; base projects moderately beyond plane of clypeus; length slightly exceeds their space, and nearly equals radial and digital joints of palpus together.

Maxillæ brownish-yellow, clouded, pale round apex, moderately dilated, well rounded, curved somewhat towards each other.

Labium shade darker; about as broad as long, sub-oval.

Sturnum dull brown-pink, clouded round margins with olive-brown; ovate.

Legs light brownish-yellow, sensibly tinged with olive-green; annuli olive-green, more or less interrupted, not well defined; about 4, 2, 3, 3 rings on the respective joints; armature does not differ essentially from males.

Palpi and legs concolorous, annulations somewhat broken, wide; two on humeral, single rings on three following joints; hairs light; pars humeralis armed with five strongish spines on superior aspect, three shortest arranged in a transverse line at fore-end, cubital joint rather shorter than penultimate article, projects a slender bristle; radial joint visibly shorter than digital, two latter joints furnished with bristles.

Abdomen oblong-ovate; rather thickly clothed with close-lying, white and yellow-ochreous hairs; more sparingly with erect black; ground colour brownish-yellow, tinge of olive-green; fuscous spots and marks, more specially on lateral borders of anterior half; indications of cross arcuate lines on posterior incline; fore-half displays an oblong-lanceolate figure thickly covered with white and yellow-ochreous hairs, latter occur chiefly on margin, which exhibits three pairs of fuscous dots; terminal third much compressed by a V-shaped dark-brown mark. *Corpus vulvæ* red-chestnut; plano-convex elevation, transversely wrinkled, apex truncated; margins at base prolonged forwards and inwards towards each other, convex, apices rounded, glossy brown; orifice of corpus closed by a large, protruding, creamy-brown, tumid, tongue-like scape, nearly as wide as long; projecting very perceptibly beyond lateral elongated margins.

Lycosa festiva, sp. nov.

Fem.—Ceph. th., long, 3·8; wide, 2·9. Abd., long, 3·8; wide, 2·5. Legs 4, 1, 2, 3=14·3, 10·5, 9·9, 9 mm.

Cephalothorax yellow-ochreous; a bright red-lake figure tapers from hind row of eyes to limit of caput, lake colour encroaches over facial space; thoracic part displays two wide fuscous bands—tri-serate on outer side, curving from base to fore-end of caput; lateral margins lightly pencilled with lake; hairs white, somewhat sparse, patchy on dorsal line; six strong bristles project from margin of clypeus; broad ovate; pars cephalica sub-quadrate, sides roundly impressed, ocular region somewhat elevated; *clypeus* in depth equal to rather more than one-half of space occupied by anterior row of eyes; pars thoracica moderately convex; groove longitudinal; radial striæ fairly well defined; contour of profile ascends from thoracic junction at an angle of 40 deg., slopes slightly forwards, dips abruptly from verge of second row of eyes.

Eyes on black spots; anterior row strongly recurved; centrals about twice as large as side-eyes of same row—latter pair broad-oval—more distant from one another than they are from laterals, an interval visibly less than their radius; eyes of second row sensibly larger than fore-centrals, divided by a space equal to three-fourths their diameter, less than twice that interval from anterior median pair; dorsal eyes do not differ essentially in size from fore-centrals, posited obliquely on rather strong, lake-black, lateral processes, interval separating them nearly equal to twice the space that divides them from eyes of second line.

Falces ochreous-yellow, traversed by a wide, olive-green, centre band; furnished with white and long black hairs; conical, retreat visibly, stout; slightly shorter than the pars digitalis of palpus.

Maxillæ straw colour; breadth surpassed by length; superior angle rounded; inferior, obliquely truncated; inclined towards one another.

Labium shade deeper than maxillæ, wider than long, subcircular, abscinded.

Sturnum ochreous-brown, wide brown border; broad oval; fairly well clothed with white hairs.

Legs, inferior aspect dark stone colour, densely clouded with olive-green; superior surface ochreous-yellow, sharply defined from lower; two first pairs suffused—above, with lake; thighs of third pair somewhat spotted, of fourth suffused with lake; patellary joints streaked; tibiæ, metatarsi and tarsi spotted; hairs white and yellow, fine, erect, black, sparse; about 6 black spines project from femora; tibial joints of first and second legs have 2, 2, 2 beneath; metatarsi 2; spine armature of hind pairs more numerous and irregular.

Palpi dull gamboge colour, marked with olive-green and lake spots or broken annuli; hairs whitish, sparse; black, bristle-like spines on all joints; pars humeralis of even width; cubital joint sub-campanulate; radial shorter and stouter than digital.

Abdomen oviform; hairs white, tolerably thick, erect, black, sparse; gamboge colour, brownish tone obtains on posterior incline; sparingly spotted with reddish dots; medial figure broad, gradually dilated from base, abruptly truncated, unicrenate at termination of second third; encroaches into second half of dorsum; of a soft fuscous black, laterally bordered by a dense, narrow fringe of whitish-yellow hairs; indications of brownish, longitudinal streaks on hind slope; lateral margins exhibit two dusky longitudinal stripes; ventral region bounded by brown dots; spinners brown-pink. *Vulva* normal shade, represents a simple longitudinal elevation, bounded below the genital aperture by a moderately developed, transverse ridge.

Single example.

Fam.—ATTIDÆ.

Gen.—PLEXIPPUS, C. Koch.

Plexippus validus, sp. nov.

Mas.—Ceph. th., long, 5; broad, 4; height, 2·2. Abd., long, 4·5; broad, 4. Legs, 1, 4, 2, 3=13, 11·4, 11, 10·8 mm.

Cephalothorax lake-brown, densely suffused with black; hairs sparse, black, orange-red, and white, two latter fine, not very perceptible; iredies orange; clypeus fringe yellowishl sparse; rugulose; pars cephalica plane, limited by a tolerably deep transverse indentation, sides rather abrupt; depth of *clypeus* about equal to interval separating anterior centre eyes; pars thoracica moderately dilated, one-third longer than cephalic part.

Anterior row of *eyes* moderately recurved, laterals fully one-third size of centrals, removed from them by an interval [illegible] equalling their own diameter; median pair about [illegible] eyes of second row visibly closer to [illegible] rather smaller than laterals, [illegible] than cephalothorax at that [illegible] ird wider than long.

[illegible] gose; vertical, flatly [illegible] d by a rather wide obovate space; extremity of falces somewhat squarely truncated, anterior fourth—inner side drawn out into an obtuse, sharply upturned, flattish process, whose apex is twisted forward, project two black tooth-like sub-processes; inner row of teeth long, close together, stouter than outer; latter project from a strong subquadrate process, broader than long; centre tooth longest and stoutest.

Maxillæ lake-chocolate, fading into a brownish tone at angles; anterior half sharply dilated—especially superior angle; rounded, slightly inclined towards each other.

Labium conical, more than half length of maxillæ, colouration similar.

Sturnum brownish-yellow, approximating to olive-green; hairs whitish; ovate.

Legs, femoral joints fuscous-lake; patellæ and tibiæ of I.—II. lighter shade; metatarsi orange-lake, white basal and distal annulations of a deeper tone; patellary and tibial joints of III.-IV. legs have a more yellowish shade than the fore pairs. indications of rings on tibiæ; metatarsi and tarsi brownish-yellow, dark annulations on former articles. White hairs short, sparse; black, numerous, long; fairly-well armed with spines. Legs stout I.-II., III.-IV. of about equal strength; patella and tibia of first leg cylindrical, slightly surpass cepholothorax in length, latter article one-sixth longer than former; metatarsus and tarsus just exceed tibia.

Palpi and legs concolorous; well armed with long, pale yellow and black hairs; first part of the pars humeralis compressed, second half gradually incrassated in length, exceeds by one-fourth cubital and radial joints together; pars cubitalis, viewed from above, sub-quadrate, radial joint somewhat shorter and narrower than latter article, obliquely truncated beneath, outer margin prolonged forwards into a into a black spine-like down-curved process, equal to half length of joint; pars digitalis equals humeral joint in length; lamina elongate-ovate, convex, well haired; genital bulb yellowish-brown, clouded with olive-brown, well developed, conical, apex projects backwards into cavity beneath radial joint; base truncated, of a creamy-brown colour, encircled by a black, corneous, spine-like costa, broad on inner side; concave, centre elevation deeply incised.

Abdomen ovate; dorsal region grayish-fulvous, pattern without any very determinate limits; more thickly, but less brightly haired than female.

Mas. max. length, 10·5; min. 8. *Fem.* max. length, 9·8; min. 8 mm.

Fem.—Ceph. th., long, 4; wide, 3. [Abd., long, 5·2; wide 3·8. Legs, 4, 3, 1—2=9, 8,7·5 mm.

Cephalothorax deep lake, passing into lake-black on borders of eye area and sides. Hairs long, black, orange-red and white; former mostly on fore-part of caput; clypeus fringe somewhat sparse, whitish. Elevated, cephalic part plane, inclined, limited by a very perceptible transverse depression; *clypeus* in height scarcely equal to radius of a lateral eye; thoracic part only moderately dilated, sides rather abrupt; scarcely one-third longer than cephalic part; dips at an angle of 40deg. to stalk.

Eyes do not differ essentially from males, except that in the first row they are comparatively and actually rather closer to each other.

Falces lake-brown; few white hairs; transversely rugulose; of somewhat even breadth, project forwards at base, vertical; in length equal interspace between lateral eyes.

Maxillæ chocolate-brown, inferior angle pale, few black hairs; dilated somewhat rapidly at second half, rounded.

Labium three-fourths length of maxillæ, similar colour, conical.

Sturnum light fulvous; hairs sparse; ovate.

Legs yellow-brown—first pair somewhat suffused with lake—three olive-brown annuli on femora, basal ring narrow, central and apical broad; indications of rings on patellary joints, tibiæ, basal, and pre-apical annulations; metatarsi have basal and distal. Patella and tibia of first leg equal in length, together one-fourth longer than metatarsus and tarsus. Femoral and patellary joints armed with short, black spines; tibiæ of I.—II. have 2, 2 beneath second half, 1 side spine; metatarsi 4, 4 at each extremity; tibiæ of III.—IV. about 4 spines towards fore-end; metatarsal joints 4 at base. Tarsal claws—1st pair, long, somewhat depressed in centre, free end well curved; outer claw 12 or more tolerably stout teeth; inner about 30 fine, close teeth; claw-tuft dense, rather longer than claw.

Palpi colour and armature of legs.

Abdomen ovate—somewhat more pointed than male—base squarely truncated; most of dorsal aspect occupied by a pale, brownish fawn-coloured, crenate, lanceolate figure, stained with blue-black; median band extends from anus to anterior fourth, represents a series of about five brown chevrons, of irregular form, apices directed forwards, terminates with a trapezoidal mark. Hairs, coarse black, white, and orange-red, two latter tolerably thick, growing chiefly in angular lines on dorsum; somewhat sparse on lateral margins, which are light brown, shading rapidly into black-brown about border of folium. Vulva brownish-amber colour; slightly elevated, oval; area occupied by involute, convex costæ, enclosing shallow, reddish foveæ, intersected by a rather narrow septum; costæ dilated on superior side of corpus.

Two males and four females of this fine species were contained in *Mr. Alex. Morton's* second collection; they varied somewhat in density of coloration, and in clearness of outline of the specific pattern. Darkest male and lightest female described.

NOTES ON THE USE OF THE SQUARE-SET SYSTEM OF TIMBERING IN MINES AT ZEEHAN AND DUNDAS.

ILLUSTRATED BY A MODEL SQUARE SET.

BY A. J. TAYLOR, F.L.S., F.R.G.S.

ELGIN MARBLES.

BY MONTAGUE RHYS-JONES, C.E.

NOTES ON SOME TASMANIAN INSECTS.

BY A. MORTON, F.L.S.

THE CLIMATE OF EASTERN TASMANIA INDICATED BY ITS LICHEN FLORA.

By Rev. F. R. M. Wilson, Kew, Victoria, Cor. Mem. Roy. Soc., Tasmania.

During a visit of five weeks to Tasmania, in February and March, 1891, while exploring for lichens in the neighbourhoods of Launceston, Mount Arthur, Ulverstone, Hobart, Mount Wellington, the Huon River, and St. Mary's Pass, I was struck with the general and unexpected poverty of the lichen flora, and, on looking about for the cause of this, I noted the evident frequency of bush fires, which are the most destructive enemies of lichen growth. This, however, did not wholly explain the matter, for, even where the plants might be expected to recover from the action of the fire, their vitality seemed to be checked by the dryness of the climate. This was a discovery surprising to a Victorian, who had been accustomed to consider the climate of Tasmania a humid one. An examination of meteorological authorities, however, showed that in the eastern portion of the island the rainfall is not only less than it is in the western, but less than it is in Victoria. In the west and the highlands of Tasmania 75in. of rain have been registered in one year, and the average of the whole island is said to be 35in.; but the annual rainfall at Hobart is only 21·52in.

These adverse influences of fire and drought doubtless react on one another, the fires thinning the forests and undergrowth, and thus lessening the rainfall, and the lack of rain exposing the country to the ravages of fire.

These influences, however, are considerably modified in the eastern part of Tasmania by the altitude of the mountains and by the ocean currents along the coast, both of which have a great effect upon the geographical distribution of lichens.

When I visited Tasmania I was anxious to test a theory which I entertained with regard to the distribution of lichens in Australia. This theory was that the warm current from the tropical Pacific Ocean, passing down the east coast of Australia, carries southward the spores of tropical lichens and the conditions favourable to their growth, until it is met by the cold south-west seas and winds which greet the traveller when doubling Wilson's Promontory from the east. Nautical observations have determined the trend of this coastal current, and traced it from the tropics southward beyond Australia and along the eastern coast of Tasmania.

Nylander tells us (Syn. Meth., p. 69) that the tropical zone is specially characterised by its epiphyllous lichens, notably by the genus *Strigula*, and, among corticole lichens, by the numerous species of *Thelotrema, Graphis, Chiodecton, Glyphis, Trypethelium*, and *Porina*.

These genera, which are allied to the *Ascomycetes* among the Fungi, are largely represented in Queensland, on the eastern or seaward side of the coastal ranges. All of them, except the *Porinæ*, appear along the coast of New South Wales, but are less numerous there, both specifically and individually. In Victoria neither *Strigulæ* nor *Porinæ* have been found unless in a very undeveloped state; and the other genera have far fewer representatives than in the more northern colonies. They are most frequent in the eastern part of Victoria. I discovered many species of *Graphis* and *Thelotrema* and several *Chiodecta* on the seaward slope of the dividing range to the east of Melbourne, and especially on the Gippsland coast, and one *Glyphis* and one *Trypethelium* at the Lakes Entrance in Gippsland.

It remained to be seen whether or not my theory would be supported by lichenological explorations in Eastern and North-eastern Tasmania. I had opportunity to test it on Mt. Arthur and in St. Mary's Pass. And I found some of the same *Graphides* and *Chiodecta* and even a *Trypethelium*, which I had collected near Sydney and at the Lakes Entrance in Victoria. Two or three species of *Chiodecta* I found, not only on Mt. Arthur, but even as far south as Mt. Wellington. The genus *Trypethelium* is especially tropical or sub-tropical. And the presence of one of this genus in St. Mary's Pass testifies to the geniality of the climate in Eastern Tasmania.

As in Victoria, so in the more southern colony, the warm current down the east coast of Australia brings southward conditions favourable to the growth of sub-tropical lichens.

These facts, I think, suggest to the medical faculty what, probably, their experience has already proved, that the climate of East Gippsland, and the eastern coast of Tasmania must be pre-eminently beneficial to invalids. Lichenological observations indicate that both of these places are favoured by a much milder winter, as well as a cooler summer, than the other parts of their respective colonies.

TASMANIAN LICHENS.

By Rev. F. R. M. Wilson.

Part I.

There is no class of plants which ordinary people know or notice so little as lichens. Yet this does not arise from their rarity or the sparseness of their distribution, for they grow almost everywhere on the globe, especially in the temperate and polar zones; and some species are very numerous. For example, the "reindeer moss," as it is called, while it is found in all cool climates, grows in the Arctic regions so profusely that the individual specimens of it are said to greatly outnumber those of any other species of plant throughout the world. The range af altitude and position also is very extensive. Some species are found on Alpine heights where no other vegetation exists; and some grow on the seaside, between high and low water. Some thrive on hard rocks exposed to the noonday sun; and some delight in the shade of caves and forests. The substrata on which they grow are various. Sandy earth, clay and loam, sandstone, granitic, basaltic, and calcareous rocks, dead wood, the bark and leaves of trees, mosses, etc., even dried bones, leather, iron, and glass afford them foothold. But they seem to absorb very little nutriment from any of these substrata; and most of them indeed live wholly on air and moisture. The two great enemies of lichen growth are lengthened droughts and frequent bush fires. From the effects of the latter agency many parts of Tasmania, especially in the eastern half of the island, have been much denuded. It is possible that in the wilder and moister west there may be fuller scope for the adventurous lichenologist. There may be species found there which do not grow in the eastern parts; and the converse will doubtless be found true.

1. The Collection of Lichens is very simple. They are removed by a sharp knife from the bark of trees, or with the bark and a piece of the wood, or by a small cold chisel from dead wood and rocks; and they need merely to be wrapped in soft paper—old newspapers will do—and carried home with just sufficient care to prevent their being bruised or rubbed. Their preservation is also simple. Few of them need any preparation if they are collected in a proper state, neither wet nor too dry. They can be glued down, as they are, on to a slip of paper, on which the date and place of collection should be noted, with the name of the collector.

2. THE EXAMINATION OF LICHENS is a somewhat more difficult matter. Although their anatomical parts are few, and their various organs comparatively simple, these are often so minute as to require the use of a microscope with a good quarter-inch objective. The *apothecium* or fruit is of various forms, but invariably contains *thecæ* or bags which hold the spores. The usual number of spores in each theca is eight. When large they are reduced even to one, and sometimes they are very minute and numerous. The *spermagones* are small nuclei form organs, containing and ejecting the *spermatia*, which are very minute, and are supposed to fructify the apothecia. The *thallus*, or vegetative part of the plant, is either crustaceous or foliaceous. The latter is the typical form, and is generally composed of three strata—cortical, *gonidial*, and medullary—of which the gonidial is specially characteristic.

3. HOW TO KNOW A LICHEN.—If it is desired to know whether a plant is a lichen or not, cut off a minute portion of the thallus and lay it on a glass slip. Moisten it with a drop or two of water, and then bruise it down gently with a penknife till it seems all melted down; put on a small glass cover and submit it to the microscope, as above. If it be a lichen, there will be found small greenish or yellowish cells, with transparent walls, called *gonidia*, or bluish cells without walls, called *gonimic granules*. The latter are sometimes conglomerated in sacs of various sizes and shapes, or concatenated like a necklace, or scattered more or less widely through the substance of the plant. It will be well to try several portions in case the first examination shows none of these cells. Some lichens, however, are nothing but apothecia, and grow on the thallus of other lichens. The class to which these apothecia belong is determined by their general likeness to the apothecia of other lichens.

4. CLASSIFICATION.—This class of plants finds its place between the algæ and the fungi; many obscure plants of the lower forms being with difficulty distinguished from algæ, and many species having so strong an affinity to fungi that it has often been a question whether they do not belong to that class.

The family which bears the closest affinity to the algæ is that of the COLLEMACEÆ, so called from their gelatinous appearance (Greek *colle*, glue) when moistened. Some of these, indeed, which grow on maritime rocks and are washed daily by the tide are very readily mistaken for

Closely connected with this fam
MYRIANGIACEÆ (Greek *myrios*, man
there are only two or three speci

The family of Lichenaceæ, or lichens properly so called, includes all the other species, and is divided into six series.

The Epiconiodei, or dusty fruited series (Greek *epi*, upon, *conia*, dust) are readily distinguished from all the other families by the pulverulent spores on the surface of the apothecium.

The Cladodei, or shoot-like series (Greek *clados*, a shoot) have peculiarly fungoid apothecia growing mostly on the summit of *podetia*, or stems rising from a foliaceous thallus.

The Ramalodei, or branch-like series (Latin *ramale*, a branch) have apothecia with a thalline margin, which grow on a generally pendulous thallus.

The Phyllodei, or leaf-like series (Greek *phyllon*, a leaf) have their thallus depressed to the substratum, and lobed.

The Placodei, or plate-like series (Greek *plax*, a plate) have a crustaceous thallus,

The Pyrenodei, or nut-like series (Greek *pyren*, a nut) are marked by the fructification being in closed receptacles.

5. Tasmanian Lichenology.—The lichens of Tasmania have had more attention paid to them than those of Australia. As far back as 1802, Mr. Robert Brown, who accompanied Flinders on his voyage round Australia, collected and named a number of lichens, which have been examined in the light of more modern knowledge and re-named by Rev. Mr. Crombie in a paper given to the Linnæan Society of London (Journ. Linn. Soc.,vol. 17 pp. 390-401). Of these 50 are from Tasmania.

In 1839-1843, Mr. Joseph D. Hooker accompanied Sir James Clark Ross in a voyage of discovery to the Antarctic regions, in Her Majesty's ships the *Erebus* and *Terror*. Mr. Hooker was assistant surgeon of the *Erebus* and naturalist of the expedition. Among other places visited was Tasmania. There they found several zealous botanists, who had been inspired by a Mr. Robert Lawrence, and who assisted Hooker in making a botanical collection in the island. On returning to England, Hooker drew up and published in 1847, under authority of the Lord Commissioners of the Admiralty, an account of the botany of the voyage. The third and fourth volumes contain the Flora Tasmaniæ, in which Rev. J. C. Babington and Mr. Mitten describe the lichens, Mr. Mitten undertaking the crustaceous kinds. They enumerate 92 in all, two of them being described as new. The names of the collectors are given: Hooker, Lawrence, Ronald C. Gunn, Charles Stuart, employed by Mr. Gunn, William Archer, of
, of Hobarton, Dr. Scott, and A. Old-
turn to England the lichens sent to
homas Taylor, and his determina-
don Journal of Botany, 1844-

A number of specimens were collected subsequently by Charles Stuart for Dr. Ferdinand Müeller, of Melbourne, now Baron Von Müeller, and were transmitted by him to Dr. Hampe, of Germany, in 1850, who published the names and descriptions of 34 in Schleehtendal's Linnæa for 1852, p. 709, etc., under the title of Plantæ Muellerianæ. Another small collection was forwarded long after by Dr. Müeller to Dr. Krempelhuber, of Germany, who published his determinations of 37 species in Den Verhandlungen des Kaiserlich-Koniglichen Zoologisch-botanischen Gessellschafft in Wien, 1880, p. 329, etc. These last have been revised by Prof. Jean Müller, of Geneva, in the Ratisbon Flora, 1887, No. 8.

The lichens determined by Hampe and Krempelhuber are enumerated in the supplements to the 11th volume of the Fragmenta Phytographiæ Australiensis.

Dr. William Nylander, in his synopsis Methodica Lichenum, 1858-1860, describes several Tasmanian lichens not mentioned by others.

Twenty-two species, determined by Prof. J. Müller, are enumerated by Baron Von Müeller in the Victorian Naturalist, October, 1887, p. 89.

6. HERBARIA OF TASMANIAN LICHENS are not deposited, so far as I am aware, in any public institution in the colony to which students could refer. I believe that Brown's collection is in the British Museum, Hooker's in the Kew Museum, in England, Nylander's in the Paris Museum, Hampe's among his Lichenes Exsiccati, and Krempelhuber's in his herbarium at Blankenberg. A few Tasmanian specimens will be found also in the Botanical Museum in Melbourne.

There are several collections in private hands. Mr. Augustus Simson, of Launceston, and Mr. W. A. Weymouth, of Hobart, to both of whom I was kindly introduced by Mr. A. Morton, Sec. R.S., T., have made collections of Tasmanian lichens, and generously allowed me to select any specimens from their herbaria. Mr. R. A. Bastow, formerly of Hobart, now of Melbourne, made a considerable collection with the intention of following up his able descriptions of the Mosses and Hepaticas of Tasmania in the Proceedings of the Royal Society of Tasmania, by describing the lichens of the island. It is to be regretted that he is unable to continue his valuable work. In a most generous manner he handed over to me his whole collection, that I might make such use of it as I thought fit. And having myself made a large collection during a late visit to Tasmania, I possess a somewhat extensive herbarium of Tasmanian lichens. I have consulted the lichen herbarium in the Botanical Museum in Melbourne as well as my own in the drawing up of this paper, and also the literature specified above. For the naming of Messrs. Simson's, Bastow's, and Weymouth's specimens I alone am responsible.

7. GEOGRAPHICAL DISTRIBUTION.—In Rev. Mr. Crombie's paper are recorded many of the places where Brown collected his various specimens. These places are scattered over the colonies of Tasmania, Victoria, South Australia, New South Wales, and Queensland. But these divisions were not known to Brown, and are not noted by Crombie. There has been some difficulty in determining the spots. For example, Table Mountain was found to be the name of what is now Mount Wellington in Tasmania, and is not to be confused with Table Mount near Lake Sorell. Derwent River and Risdon Cove were of course readily recognised. Anna Maria River was with some difficulty decided to be a small stream running down to D'Entrecasteaux Channel in Tasmania. On the other hand, Grose River was found in Flinders chart of New South Wales as a tributary of the Hawkesbury. Crombie seems, however, to have considered it a Tasmanian stream, for one of the lichens found by Brown at Grose River is named by Crombie *Ephebe Tasmanica.* Kingstown has not been included in Tasmania, though there is a place on the Derwent called Kingston, because the lichen said to have been found there, *Physcia picta,* is a tropical plant, not found, I believe, either in Tasmania or in Victoria. The Kingstown mentioned by Brown may probably be an island off the coast of Western Australia, 32deg. S., 115·30deg. E.

Hooker, in his Flora Tasmanica, mentions as habitats of lichens "The Springs" on Mount Wellington, Cheshunt, Esk, at Launceston, Macquarie Plains, Richmond, Back River, and Southport. The other publications do not specify the habitats. Mr. Simson collected on the Blue Tier, Mr. Weymouth and friends, and Mr. Bastow and friends collected in Maria Island and Tasman Peninsula, on Mount Wellington and about Hobart, at the Gordon River, and in the neighbourhood of Southport; and myself about Launceston, Mount Arthur, Hobart, Mount Wellington, St. Mary's Pass, the Huon River, and Ulverstone.

CLASS OF LICHENS.

Thallus containing gonidia or granula gonima variously disposed, and also very often crystals of oxalate of lime in the crutaceous species. Fructification consisting of apothecia, containing spores in thecæ. Spermatia in nucleated conceptacles—spermagones—distinct from the apothecia.

The families and their principal divisions are founded on the diversities of the thallus, and sometimes on those of the apothecia, and even of the spermagones.

wards expanding into a larger frond, which is much sinuated and tomentose beneath, with rather shaggy down, as in *Leptogium saturninum* (to which, however, this cannot belong, not being a Leptogium), and then resembling a young frond of *Stictina fuliginosa.* Apothecia plano concave, dull red, fringed with the minute, crenated thallodal at margin, then convex, emarginate."

Sub-genus Synechoblastus.

Spores narrow or fusiform.

5. *C. nigrescens,* Huds., nigro virescent, thin, membranaceous, sub-monophyllous, orbicular, depressed, rotundo lobate, radiato rugoso plicatulate, naked or granulate, ascending in the centre, depresso adnate at the circumference. Apothecia dark rufous, plane, small, crowded, thalline margin entire. Spores fusiformi cylindrical, pluri-septate, ·034 to ·042 × ·005 mm.
Hab. on old trees by Derwent River, *Brown,* Cr.

6. *C. leucocarpum,* Tayl. *C. nigrescens var. leucocarpum* of Babington, olivaceous, foliaceo membranaceous, 1 to 3 inches diam., smooth, lobate, lobes rotundate, undulate and plicate, margin flexuous. Apothecia often crowded, albo carneous, convex, pruinose, margin entire, at length withdrawn. Spores elongato fusiform, often acuminate at apices, 3 to 5 septate, ·03 to ·05 × 006 to ·01 mm.
Hab. on trees, Derwent River, *Brown,* Cr.; Hook. L. J. Bot.; Circular Head, *Gunn,* Hook. Fl. Tasm.; Krplh.; *Stuart* in herbar. Bot. Mus., Melb.; Mount Wellington, (and *Weymouth)* Brown's River, St. Mary's Pass; Macrobie's Gully, and New Town Falls (*Bastow*). Mr. Crombie says = *C. glaucophthalmum,* Nyl., which is a mistake. Though somewhat alike, they are quite distinct. *C. glaucophthalmum* is frequent in Victoria, but has not yet been found in Tasmania. It is likely, however, to occur associated with *C. nigrescens.*

7. *C. aggregatum,* Ach., *var. thysanæum,* Moug. *C. thysanæum,* of Babington, nigrescent, membranaceous, lobate, plicate, difformed, lobes sometimes crenate, margins often granuloso crispate. Apothecia dark rufous or rufous, moderate, crowded, with thin thalline margin. Spores 8 or 6, fusiformi cylindrical, pluri septate, not rarely somewhat curved, ·033 to ·065 × ·004 to 005 mm.
Hab. on bark, Cheshunt, *Archer.* Hook. Fl. Tasm.

8. *C. quadriloculare,* Wilson, *var. Tasmaniæ,* Wilson, fusco olivaceous or nigricant, membranaceous, adhering, lobate, thicker at circumference, crisped. Apothecia moderate, crowded, black or rufous black, plane, or somewhat concave, with entire thalline margin. Spores cylindrical, rounded at each apex, somewhat curved, 8 locular, ·04 to ·05 × ·003 to

4. PYRENOPSIS. Nyl.

Thallus crustaceous granuloso areolate, internally rubricose, laxly cellulose. Granula gonima agglomerated in globular sacs. Apothecia concolorous, minute, urceolate, innate in a prominent marginal receptacle; margin somewhat swollen and connivent. Spores simple.

1 *P. Tasmanica*, Nyl., fuscous black, thin, effuse, subtilely rugulose above, diffracto glomerulose, glomerules equal. Apothecia many in each glomerule, somewhat impressed, often crowded. Spores ellipsoid or sub-globose, ·004 to ·005 × ·0025 to ·003 mm. No distinct paraphyses. Gel. hym. I. cærulescent.

Hab. on granite rocks, St. Patrick's River. Hook. L.J., Bot.: Nyl.

5. COLLEMA. Ach. Nyl.

Thallus various, no distinct cortical layer. Granula gonima moniliform. Apothecia rufescent, with thalline margin, Spores simple or variously septate.

Sub-genus Collema.

Spores more or less ellipsoid.

1. *C. flaccidum*, Ach., dark green, opaque, membranaceous, lobate, lobes large, expanded, flexnose. Apothecia plane, rufescent. Spores ovoid or broadly fusiformi oblong, ·023 to ·028 × ·007 to ·01 mm.

Habitat on woodland rocks. Hook. L.J. Bot.; on bark, Cheshunt, *Archer*, Hook. Fl. Tas.

2. *C. implicatum*, Nyl. Not enumerated in Nyl. Syn. Meth. Hab. by Derwent River, *Brown*, Cr.

3. *C. læve*, Tayl., olivaceous, under surface paler or cinerascent, smooth, rotundo lobate, undulate. Apothecia rufous or fusco rufous, plane, at length convex, with a thin entire thalline margin. Spores fusiformi ellipsoid, ·013 × 004 mm., 3 to 5 septate, and also longitudinally divided. Granula gonima moniliform. Gel. hym. I. blue.

Hab. among mosses on rocks. S. Esk, Launceston; Mount Wellington, *Weymouth*.

4. *C* ——. In Hooker's Fl. Tasm. Babington says:—"Mr. Archer has found at Cheshunt a species of Collema different from any of those described above, but has unluckily preserved only one specimen. It is unknown to us, and may be new. The dull green thallus grows among mosses, has membranous rounded lobes, in a young state resembling *C. crispum*, Schær. (*C. cheilum*, according to Nylander), but after-

GENUS 1. MYRIANGIUM. Mnt. and Berk.

Characters above, as there is only one genus in the family.

1. *M. Duriæi,* M. and B., black, opaque, small, tuberculato glomerate or noduloso confluent, often depresso pulvinate. Apothecia small, black, slightly impressed. Spores oblong or oblongo ovoid, variously septate, ·02 to ·036 × ·009 to ·016 mm. Gel. hym. I. vinous.

Hab. on bark of trees, especially on *Acacia decurrens,* S. Esk at Launceston, St. Mary's, Hobart, Mount Wellington (and *Weymouth*), Huon River.

FAMILY 3. LICHENACEÆ.

Thallus various in colour—white, whitish, cinerascent, flavicant, rufous or fuscous, rarely nigrescent, various in form—filamentous, foliaceous, squamose, crustaceous, pulverulent, or evanescent. Apothecia various—stipitate, lecanorine, peltate, patellulate, lirellate or pyrenoid.

SERIES I. EPICONIODEI.

Apothecia with the spores naked, collected into a sporal mass on the surface, Spores 8 in theca.

GENUS 1. CALICIUM. Ach. Nyl.

Thallus filmy, granulose, powdery, squamose, or evanescent. Apothecia minute, black, stipitate or subsessile, capitula globose, or turbinate, or cupular. Spores fuscous or nigricant.

1. *C. phæocephalum,* Bor., *var. albidum,* Wilson, whitish, thin, smooth. Apothecia with slender, black, or fuscous stipe 1·5 mm. high, ·05 mm. thick; capitula obconical, ·2 mm. broad, with citrine powder on margin and beneath, sporal mass umber; spores spherical, diameter ·002 to ·003 mm., dilutely fuscescent, containing a central locule.

Hab. on decorticated decaying eucalyptus, and on stringy bark of growing eucalyptus. Mount Wellington.

2. *C. Victoriæ,* C. Kn., white or whitish or cinerascent, more or less marked, effuse. Apothecia black, ·5 to 1 mm. high, stipe ·1 mm. thick, incrassate towards the base; capitula turbinato lenticular, or hemispherico lenticular, ·25 to ·5 mm. broad. Spores simple, fuscous, or fuscescent, nucleus darker, fusiformi ellipsoid, compressed, ·005 to ·008 × ·002 to ·003 mm., and when viewed from the side ·0015 wide; paries thick, defined by a dark line on the outside.

Hab. on decorticated decaying eucalyptus. Mount Wellington (and *Weymouth*), Mount Arthur.

THE CLIMATE OF EASTERN TASMANIA INDICATED BY ITS LICHEN FLORA.

By Rev. F. R. M. Wilson, Kew, Victoria, Cor. Mem. Roy. Soc., Tasmania.

During a visit of five weeks to Tasmania, in February and March, 1891, while exploring for lichens in the neighbourhoods of Launceston, Mount Arthur, Ulverstone, Hobart, Mount Wellington, the Huon River, and St. Mary's Pass, I was struck with the general and unexpected poverty of the lichen flora, and, on looking about for the cause of this, I noted the evident frequency of bush fires, which are the most destructive enemies of lichen growth. This, however, did not wholly explain the matter, for, even where the plants might be expected to recover from the action of the fire, their vitality seemed to be checked by the dryness of the climate. This was a discovery surprising to a Victorian, who had been accustomed to consider the climate of Tasmania a humid one. An examination of meteorological authorities, however, showed that in the eastern portion of the island the rainfall is not only less than it is in the western, but less than it is in Victoria. In the west and the highlands of Tasmania 75in. of rain have been registered in one year, and the average of the whole island is said to be 35in.; but the annual rainfall at Hobart is only 21·52in.

These adverse influences of fire and drought doubtless react on one another, the fires thinning the forests and undergrowth, and thus lessening the rainfall, and the lack of rain exposing the country to the ravages of fire.

These influences, however, are considerably modified in the eastern part of Tasmania by the altitude of the mountains and by the ocean currents along the coast, both of which have a great effect upon the geographical distribution of lichens.

When I visited Tasmania I was anxious to test a theory which I entertained with regard to the distribution of lichens in Australia. This theory was that the warm current from the tropical Pacific Ocean, passing down the east coast of Australia, carries southward the spores of tropical lichens and the conditions favourable to their growth, until it is met by the cold south-west seas and winds which greet the traveller when doubling Wilson's Promontory from the east. Nautical observations have determined the trend of this coastal current, and traced it from the tropics southward beyond Australia and along the eastern coast of Tasmania.

turbinato globose, ·2 to ·5 mm. broad, margin white. Spores fuscous, fusiformi ellipsoid, sub-acuminate at each apex, somewhat constricted in the middle, uniseptate, with a fusco nigrescent locule in each cell, ·008 to ·012 × ·003 to ·005.

Hab. on decorticated decaying eucalyptus at foot of Mount Arthur.

2. Trachylia, Fr., pp. Nyl.

Thallus thin, granulose or sub-leprose or smooth or foreign. Apothecia black, sessile, cupuliform, open; sporal mass black. Spores nigricant or fuscous black, ellipsoid or oblong, uniseptate, rarely pluriseptate.

1. *T. emergens*, Wilson, white or whitish, thin, smooth, somewhat shining. Apothecia seeming to emerge from among the fibres of the wood, and at length barely standing out above the thallus, breadth to ·5 mm. Spores fusco nigricant, adhering closely together, ellipsoid, about ·005 × ·003 mm. but very variable in size; uniseptate, with a locule in each cell.

Hab. on eucalyptus rails in mountainous regions, Mount Wellington (and *Weymouth*), St. Mary's.

3. Sphærophoron.

Thallus cæspitoso fruticulose, ramose and ramulose, smooth, polished, fragile, fertile apices sub-globoso incrassate, enclosing the apothecia, which are nucleiform, enclosed ultimately exposed by the irregular dehiscence of the thalline covering. Spores nigricant or violaceo nigricant, spherical or subglobose.

1. *S. compressum*, Ach., pallido albicant or lurid, ramose, plano compressed. Apothecia obliquely innate on the apices, receptacle wrinkled, at length lacero dehiscent or discoid and open. Spores nigricant, spherical, ·007 to ·011 mm.

Hab. on trees in mountains, Krplh.; on *fagus*, *Gunn*, Hook. Fl. Tasm. Blue Tier, *Simson*; Tasman Peninsula, Mount Bischoff and Mount Faulkner, *Weymouth*; Gordon River, *Allport*; Maria Island, *Bastow*; Mount Arthur, Mount Wellington.

2. *S. Australe*, Laur.; glauco pallid, sometimes lurid, under surface albicant, rugose, to two inches long, branches explanate, often distichously ramulose. Receptacle 6 to 12 mm. broad, lenticulari compressed, external margin at apex cristato crenate and sometimes proliferous. Spores ·011 to ·015 mm.

Hab. on trees in mountains, *Brown*, Cr.; Cheshunt, *Archer*, on *fagus*, *Gunn*, Hook. Fl. Tasm. Mount Wellington, (and *Weymouth*); Mount Arthur, Ulverstone.

3. *S. coralloides*, Pers., pallid or whitish, sometimes lurid, ramulose, terete. Apothecia in globose receptacles irregularly dehiscent above, 2 mm. or more in diameter. Spores ·009 to ·015 mm.

Hab. in mountainous regions on stones and trunks of trees, *Brown*, Cr.; Cheshunt, *Archer*, Hook. Fl. Tasm.; Nyl,; Krplh.; Mount Wellington (and *Weymouth*), Mount Arthur.

4. *S. tenerum*, Laur., pallid or white, terete, much branched, slender, 2 to 3 inches high, with filiform intricate branches. Apothecia 1 to 2 mm. diam., on primary branches or axes, soon denuded of thalline receptacle, which is persistent at margin of base. Spores nigricant, ·007 to ·008. mm.

Hab. on trees and earth on mountains, Cheshunt, *Archer*, on *Fagus*, St. Patrick River, *Gunn*, Hook. Fl. Tasm.; Krplh; Tasman Peninsula, *Weymouth*, Mount Arthur, Mount Wellington.

SERIES II. CLADODEI.

Thallus generally erect. Apothecia terminal on podetia, rarely sessile on thallus, biatorine, rarely lecanorine. Spores 8, colourless, usually oblong and simple, sometimes elongate and septate.

GENUS I. GOMPHILLUS, Nyl., Wilson.

Thallus very thin, consisting of gonidia and filaments irregularly conglutinated. Apothecia small, stipitate by constriction of the hypothecium, of a most tenacious, horny texture. Spores 8, filiform, very long, multiseptate, in cylindrical thecæ. Paraphyse, not discrete.

1. *G. bæomyceoides*, Wilson = Patellaria Wilsoni, Müll., Arg., Lich., Beit. 1435, cinereous or virescent, effuse, very thin and somewhat shining, or thicker and eroso isidioso granulate. Gonidia various in form and size, conglomerated into gelatinous sacs. Apothecia of tenacious, horny texture, biatorine, sometimes margined by the white hypothecium, scattered or conglomerated, depresso globose, to 1·15 mm. diam., smooth, rufo fulvescent, pale when young and dark in age, sub-sessile or stipitate, stipe to ·5 mm. high and ·5 mm. thick, with sometimes 2 or 3 capitula on one stipe. Spores 8 in cylindrical thecæ, aciculari filiform, about ·14 mm. long, pluriseptate.

Hab. on roots and trunks of trees, on mosses and bark, on jungermannia and lichens, also on dead leaves, etc., on the earth, Mount Arthur.

2. BÆOMYCES, Pers.

Thallus crustaceous, powdery, granulose, or squamulose. Apothecia biatorine, sessile or stipitate.

1. *B. roseus*, Pers., *var. fungoides*, Ach., whitish, granulose, margin of granules spreading, thin, continuous (K. faint yellow). Apothecia roseo carneous or albo carneous, subglobose or globoso clavate or deformi clavate, 2 to 4 mm. broad (K. orange). Stipe 4 to 8 mm. long, whiter, subterete. Spores oblong or fusiform, simple, ·011 to ·023 × ·0035 mm. Paraphyses slender.

Hab. on earth (chiefly clay) in mountainous regions. Hook. Fl. Tasm.; Mount Wellington (and *Bastow* and *Weymouth*).

2. *B. heteromorphus*, Nyl., pallido glaucescent or pallido cinerascent, verrucoso unequal, forming large patches. Apothecia pale carneous or carneo fuscescent, ·5 to 1 mm. high, variously compressed or plicate, often 2 to 6 or more conglomerated on one stipe. Spores very transparent, ellipsoid, simple, ·01 × ·006 mm. (Thal. and Ap. K. + C. −).

Hab. on clay, mosses, dead leaves, etc., in mountainous regions, *Oldfield*, *Gunn*, Cheshunt, *Archer*, Hook. Fl. Tasm.; Nyl.; Tasman Peninsula and St. Crispin's (and *Weymouth*), Mount Wellington (and *Bastow*) ; Ulverstone.

3. *B. squamarioides*, Nyl.=*Parmelia splachnirima*, Tayl.= *Placodium splachnirimum*, Tayl.=*Bæomyces splachnirimus*, Mitten = *Knightiella leucocarpum*, Müll. Arg. = *Knightiella squamarioides*, Müll. Arg., albo or albido glaucescent, subopaque, squamose, squamæ difformed, about ·5 mm. broad, affixed, forming small patches about 1 inch wide, lobate or lobato incised, plane or somewhat depressed in the centre, concolourous beneath or whiter. Apothecia lurid or pale lurid or lurido carneous, ·2 to ·3 mm. broad, biatorine, plane, margin thickish, evanescent. Spores oblong or ellipsoid or fusiform, uniseptate or simple.

Hab. on earth among lesser jungermanniæ, *Gunn*, *Stuart*, Hook. L.J. Bot.; Hook. Fl. Tasm.; Nyl.

3. Cladonia.

Thallus foliaceous, laciniiform, with podetia generally dilated at apex into scyphi, and generally foliolose or squamulose at the base, or thallus sometimes granuloso crustaceous. Apothecia variously coloured, seldom nigricant. Spores small, oblong.

Subgenus Cladonia.

Thallus foliaceous or squamose.

I. Apothecia fuscous or fuscescent.

A. Scyphophorus.

1. *C. alcicornis*, Flk., macrophylline, spreading, bluish grey or yellowish green above, white or whitish beneath, laciniæ

narrow, palmato multifid, inciso crenulate at apex, margins with black fibres. Podetia springing from upper surface of laciniæ, margins of scyphi cristate. Apothecia rufescent.

Hab. on dry heathy ground, *Stuart*, Hampe. Doubtful.

2. *C. ceratophylla*, Sw., pale glaucescent or flavido pallescent, laciniose, laciniæ profoundly divided, margin undulate or crenato incised, albid beneath. Podetia attenuate, often subulate and sterile, decorticate, white or whitish, springing from the laciniæ, scyphi narrow or scarcely any. Apothecia pallescent or sub-fuscous. Spores not seen. This plant is smaller than *C. alcicornis* and is like a large-leaved *C. fimbriata.*

Hab. B.v. m. Vic. Nat. Oct., 1887.

3. *C. pyxidata*, Fr., squamulose, ashy green. Podetia cartilaginous, corticate, verrucose, or coarsely granulato pulveraceous or scaly downwards. Scyphi cyathiform, more or less proliferous.

Hab. on earth, *Gunn*, *Oldfield*, Hook. Fl. Tasm.; *Stuart*, Hampe; *Simson*; New Town Falls and Huon-road and Launceston, *Bastow*; Mount Arthur, Mount Wellington, Brown's River; Port Arthur, *Weymouth.*

Var. 1. *pityrea*, Ach., podetia pulverulento granuloso furfuraceous, ashy white, smooth and decorticate and often ribbed or laciniose in the upper part.

Hab. Brown's River, Mount Wellington, Lilydale, Mount Arthur; Launceston, and New Town Falls, *Bastow*; Port Arthur, *Weymouth.*

Var. 2, *chlorophæa*, Flk., podetia pulverulent, granules coarser at the base, sulphury yellow.

Hab. Mount Wellington.

Var. 3, *fimbriata*, Hffm., thallus white, squamulose, podetia membranaceo corticate, deliquescing into a fine impalpable white powder, sometimes scaly from the base upwards.

Hab. Asbestos Hills, *Gunn*, Mount Wellington, *Oldfield*, Southport, *Stuart*, Hook. Fl. Tasm.; Krplhb.; Mount Wellington and New Town Falls and Launceston and Huon-road, *Bastow.*

This variety occurs in Tasmania under the following forms:—

F. radiata, Schreb., podetia irregularly scyphophorous and radiato fimbriate, with divided margin, or podetia simple, cornute.

F. antilopæa, Duby, podetia extended, slender, tapering upwards, and arcuate, with minute scyphi.

F. costata, Flk., podetia granuloso pulverulent, at length denuded, and discovering their costate substance; *Wilson* and *Bastow*.

F. longipes, Mount Wellington, *Oldfield*, Hook. Fl. Tasm.

F. coniocræa, Duby, Southport, *Stuart*, Hook. Fl. Tasm.

3. *C. cariosa*, Ach., thallus pale ashy green, scales minute, more or less investing the base of the podetia. Podetia whitish, half to one inch high, dilated upwards, carious, cancellato or eroso lacunose, granulato verrucose, scyphi digitato partite, fastigiate.

Hab. on earth, Nyl., Mount Wellington.

4. *C. gracilis*, Hffm. = *Cenomyce gracilis* of Taylor; thallus pale ashy green or livid brown, leaflets at the base often evanescent. Podetia elongate, filiform, subulate, or scyphophorous and proliferous, corticate, glabrous. Apothecia pedicellate or sessile, fuscous.

Hab. on earth. Hook. L. J. Bot. (Mount Wellington and *Bastow*).

5. *C. verticellata*, Flk. = *Cenomyce allotropa*, *var. verticellata* of Taylor; thallus foliaceo squamulose, leaflets laciniæform, crenato incised. Podetia ashy grey, corticate, glabrous or sub-verrucose, scyphophorous, scyphi denticulate at the margins, two to four times verticellato proliferous and scyphophorous from centre of scyphi. Apothecia fuscous.

Hab. on earth and among rocks, Hook., L.J. Bot.; Mount Wellington (and *Hooker*, Hook. Fl. Tasm.; and *Bastow*); Port Arthur, *Weymouth*.

6. *C. degenerans*, Flk., thallus squamulose. Podetia whitish or brown, cartilaginous, glabrous, nigrescent and albo guttate at base, scyphophorous, scyphi proliferous, cristato ramose.

Hab. on earth and among rocks, Cheshunt, *Archer*, Hook. Fl. Tasm.; Mount Wellington, Ulverstone.

7. *C. cervicornis*, Schær., thallus macrophylline, cæspitose, sub-erect, narrowly laciniato multifid, crenate, cartilaginous, glaucous green above, white beneath, purplish black at base. Podetia from disk of laciniæ, short, slender, smooth, or sub-verrucose, scyphi simple and leafless, or irregularly proliferous, and more or less squamose.

Var. stipata, Nyl., basal squamæ elongate, sub-linear, crenato incised, erect, stipate, rarely fertile.

Hab. on hills and rocks, *Stuart*, Hampe; Krplh.; Mount Wellington, Huon-road.

8. *C. decorticata (?)* Fr., thallus squamose or squamulose, glaucous above, white beneath, or sometimes nigricant, lobate and crenate. Podetia one or two inches long, cylindrical,

nearly all rough, with squamules ascyphous, or with narrow scyphi. Apothecia fuscous, often confluent.

Hab. among mosses in rocky places, Mount Wellington, *Oldfield*, Hook. Fl. Tasm.; *Coates*. Marked doubtful as above in Fl. Tasm.

9. *C. cornuta*, L. = *C. fimbriata, var. cornuta* of Babington, thallus pale ashy green, or livid brown at the base, sparsely foliolose, folioles lobate, crenate, or none. Podetia 2 to 4 inches long, upwards to beyond the middle glabrous, at the apex pulverulent, generally cornute, a few scyphophorous, scyphi narrow, often irregular, and sometimes sub-radiate. Apothecia fuscous.

Hab. on earth, Mount Wellington and Southport, *Stuart*, Hook. Fl. Tasm.

10. *C. ochrochlora*, Flk., similar to *cornuta*, but often more foliolose. Podetia glabrous, the upper half white or ochrey-white, pulverulent, apex obtuse or narrowly scyphophorous, dentato radiate at the margin, scyphi often glabrous in the cavity and at the base of the teeth, margin green.

Hab. on turfy earth and rotten trunks of trees, Mount Wellington (and *Weymouth*), Mount Arthur, Ulverstone.

B. Ascyphous.

11. *C. furcata*, Hffm., = *Cenomyce ecmocyna, var. subulata* of Taylor; thallus squamulose, evanescent, podetia elongate, pale whitish or brownish green, fruticose, glabrous, branched, branches attenuato subulate, divergenti furcate; apothecia small, fuscous.

Hab. on earth, chiefly on mountains, Launceston, *Gunn*, Mount Wellington, *Oldfield*, Hook. Fl. Tasm.; Krplh.; Mount Wellington, Knocklofty, Mount Arthur; Blue Tier, *Simson*; New Town Falls and Launceston, *Bastow*. Tasmania possesses many forms of this species, some slender, and others inflated. The most marked varieties are as follow :—

Var. 1, *adspersa*, Flk., podetia elongate, squamoso furfuraceous, sparingly branched, branches sub-simple.

Hab. Mount Wellington (and *Brown*, Cr.).

Var. 2, *squamulosa*, Mull. Arg., podetia leafy or scaly.

Hab. Mount Wellington, Mount Arthur, Tasman Peninsula (*Weymouth*).

Var. 3, *polyphylla*, Flk., podetia more or less covered with tolerably large leaflets.

Hab. Mount Wellington.

Var. 4, *attenuata*, Hffm., = *C. acuminata*, Ach. of Crombie, podetia broader, subulato rumose, branches furcate, podetia often partly decorticate.

Hab. Mount Wellington, *Brown*, Cr.

12. *C. coniodendroides*, Wilson; thallus of small pale squamules investing the base of the podetia. Podetia elongated dichotomously, divergenti furcate, with branches and ramules generally at right angles to each other, sometimes irregularly clavate or contorted and swollen, or simple and subulate, wholly covered with whitish or cinereo virescent powder. Apothecia rare, pale fuscescent.

Hab. on earth. Mount Wellington, Ulverstone; Kermandie Valley, *Bastow*. Possibly a variety of *C. furcata*. There is almost complete atrophy of the cortical layer of the podetia, leaving only a few scattered squamules, and often atrophy also of the gonidial layer, leaving only the chrondroid medulla, clothed more or less with whitish powder.

13. *C. cenotea*, Ach. = *C. brachiata*, Fr. of Hampe; thallus almost leafless, or with a few lobato crenate squamules at the base of the podetia, which are cylindrical, whitish, or cinerascent, pulverulent, axils and apices dilated, scyphoid, perforated, the margins of the apertures denticulate, and generally proliferous, the podetia then ramose, repeatedly proliferous, the apertures generally fuscescent within, apothecia pallescent or fuscous.

Hab. on trunks of trees, among mosses, *Stuart*, Hampe.

14. *C. squamosa*, Hffm., = *Cenomyce sparassa*, Ach. of Taylor and Hampe; thallus squamulose, podetia cæspitose, whitish green, cylindrical, two inches high, erect, repeatedly branched, proliferously denticulate, or subulate from margins of the minute irregular scyphi, apices rigid, sub-corymbose, radiato cristate, glabrous, longitudinally sub-lacunose, cortex entire, clothed with minute leaflets or scales, apothecia clustered, fuscous.

Hab. Cheshunt, &c., *Gunn*, *Hooker*, *Oldfield*, *Lyall*, Hook. L.J., Bot.; Hook. Fl. Tasm.; *Stuart*, Hampe; Krplhb.; Mount Wellington, *Brown*, Cr.

15. *C. delicata*, Flk., *var. subsquamasa*, Nyl. Thallus squamulose, white or cinereous; podetia whitish, slender, 1 to 2 inches high, partially glabrous, cartilaginous, longitudinally ribbed or fissured, clothed at intervals at the base with spreading, incised, and crenate scales, granulate in the upper part, branched, radiato cristate, subcorymbose; K + C —.

Hab. on decaying logs and trunks of trees. Mount Wellington; New Town Falls, *Bastow*.

16. *C. capitellata*, = *Cenomyce capillata*, Tayl., = *C. amaurocrea*, *var. capitellata* of Nyl., thallus sparingly foliolose at the base of the podetia, and occasionally throughout; podetia straw-coloured or pallid, slender, smooth, rigid, dichotomously branched, dilated here and there as if with scyphi, which are

open and subradiately proliferous, ultimate ramuli infuscate at apices, with one to four fuscous points. Apothecia shortly stipitate, brown, margin reflexed.

Hab. on rocks and earth, St. Patrick's, Hook. Fl. Tasm.; Mount Wellington, Knocklofty, Mount Arthur; S. Esk at Launceston, and Maria Island, *Bastow.*

II. *Apothecia red.*

17. *C cornucopioides,* L., albido flavescent or cinereo virescent, squamose or squamulose, squamæ lobiform, crenate or crenato incised; podetia glabrous, often granuloso unequal or squamuloso exasperate, ½in. to 1in. high, scyphophorous, scyphi regular, sometimes proliferous. Apothecia bright scarlet, sessile or podicellate on margin of scyphi, often confluent.

Hab. *Laurence,* Asbestos Hills, *Gunn,* Mount Wellington, *Oldfield,* Hook. Fl. Tasm.; Krplh. revis., Mull., Arg.; Mount Wellington (and *Bastow*).

Var. Tasmanica, Wilson, = *C. deformis, var. Tasmanica,* Krplhb. = *C. cornucopioides* Mull., Arg. Flora, 1887, No. 8; thallus foliaceous or evanescent, folioles sometimes large, lobate and crenate or laciniate, variously divided, podetia cyathiform or ascyphous, extended, sometimes proliferous or branched, lower half verucoso corticate, generally squamulose, upper half covered with depressed granules; the podetia, folioles and squamules at first light green, gradually growing fusco flavid upwards, especially at the base of the podetia and the under-surface of the folioles, the upper part of the podetium becoming a deep yellow. Apothecia conglomerate on margin of scyphus or apex of podetium.

Hab. on earth, fern trees, and decaying logs. Krplhb. in hb. Melb. Bot. Mus. (with name and description in his writing); Mount Wellington (and *Bastow*).

F. arrosa, Wilson, podetia truncated, the margin of the scyphi thickened so as to reduce the mouth almost to a point. Apothecia minute.

Hab. on decayed logs, Mount Wellington.

F. sub-macilenta, Wilson, differs from *C. macilenta* in the base of the podetia and the folioles being flavid.

Hab. on decaying logs, Mount Wellington, Ulverstone. Similar to Nylander's *C. angustata,* which, however, has virescent squamæ and sulphureous podetia.

18. *C. intermedia,* Krplhb. *Dr. Story* in hb., Melb. Bot. Mus.

19. *C. deformis,* Hffm., podetia sulphureous, pulverulent, folioles at base pallide virescent, incised, crenate, beneath

whitish or pallescent, scyphi simple, regular, or deformed. Apothecia bright red, discrete, or conglomerate.

Hab. *Oldfield*, Hook. Fl. Tasm.; Nyl.; Krplhb.; Mount Wellington, *Brown*, Cr.

It may be questioned whether the Tasmanian specimens thus named are not *C. cornucopioides, var. Tasmanica,* which is a very polymorphous variety as found in Victoria.

20. *C. Flœrkeana*, Fr., squamules at the base of the podetia crenato incised or crenate, few or evanescent; podetia white, 1 to 1½ inch high, corticate, smooth, obtuse at apex, often obsoletely scyphophorous or incrassate, or briefly divided. Apothecia often conglomerate.

Hab. Falls of the Meander, Western Mountains, *Archer*, Hook. Fl. Tasm.; Krplhb.

21. *C. digitata*, Hffm., thallus of folioles, pallide virescent, crenato incised, or lobate and crenate, underneath white or albid, and there generally pulverulent podetia albido; pulverulent, without folioles, cylindrical, 1 to 2 inches high, simple or rarely divided at the apex, scyphophorous, scyphi with margin either denticulate, or sub-inflexed, or variously divided, and digitato proliferous. Apothecia bright scarlet, small, or confluent.

Hab. Cheshunt, *Archer*, Hook. Fl. Tasm.

Var. macilenta, Hffm. = *C. macilenta* of Babington, thallus smaller or squamulose, podetia ½ to 1 inch or a little more, slender, simple, or shortly divided at the apex, ascyphous, obtuse, rarely with narrow, irregular scyphi. Apothecia confluent.

Hab. Cheshunt, *Archer*, Hook. Fl. Tasm.; Krplhb.

F. seductrix, Del., folioles more evolved, virescent, multifid, crenate; podetia narrow, cylindrical, simple. Apothecia minute.

Hab. on earth. Brown's River, *Oldfield*, Hook. Fl. Tasm.; Nyl.

Sub-genus Cladina, Nyl.

Thallus leafless, podetia without scyphi, repeatedly branched, more or less smooth. Apothecia terminal.

22. *C. rangiferina*, Hffm., cinerascent, 2 to 6 inches high, verruculoso, scabrous, sub-tomentose, terminal branches sub-corymbose, fastigiate, apices sub-secund, nodding, K + C —.

Hab. on earth. Hook. L. J. Bot.; *Cunningham*, *Gunn*, etc., Hook. Fl. Tasm.

Var. Sylvatica, Hffm., pale or straw coloured, glabrous, terminal branches radiato cymose, fastigiate, apices sub-secund, nodding, K f y C +.

Hab. on earth, Asbestos Hills, *Gunn*, Hook. Fl. Tasm.; Mount Wellington (and *Brown*, Cr.); George Town and Macrobie's Gully, and Leven River, and Oyster Cove, and Tasman Peninsula, and Maria Island, and Macquarie Harbour, *Bastow*; Port Arthur, *Weymouth*.

F. alpestris, L., white or pale straw coloured, verrucose, intertwining, and divaricately branched, densely thyrsoid at apex, more stipitate below.

Hab. on earth. Cascades and Port Arthur, *Oldfield*, Hook. Fl. Tasm.; Mount Wellington.

F. pycnoclada, Pers., white or yellow, opaque, not glabrous, cæspitose, densely ramose, byssino context.

Hab. Mount Wellington, Ulverstone.

23. *C. uncialis*, Hffm. = *Cenomyce uncialis*, Tayl., greenish straw coloured, glabrous, cylindrical, fistulose, dichotomous, branches short, apices subulate, denticulate or digitate, K — C +.

Hab. on mossy earth, Hook. L. J. Bot.; *Stuart*, Hmpe.

Possibly the specimens have been juvenile forms of *C. capitellata*.

Sub-genus Clathrina, Wainio.

Thallus efoliolose; podetia terebrate or hiascent. Apothecia usually nigricant.

24. *C. aggregata*, Eschw. = *Dufourea collodes*, Tayl., = *Cornicularia terebrata*, Hmpe., pale cinerascent or cervine, pallid or pale, chestnut-red or darker, at base fuscescent, glabrous, somewhat shining, more or less terebrate, sterile branches usually slender and alternato ramulose, with furcate apices, fertile branches thick with shorter turgescent ramules. Apothecia fuscous black or fuscescent, aggregated.

Hab. on earth, rocks, logs, and trees, abundant; all collectors, Hook. Fl. Tasm.; *Stuart*, Hmpe.; Krplh.; Mount Wellington, Mount Arthur, Ulverstone, Brown's River; Knocklofty, and Macrobie's Gully, and Cascades and New Town Falls, *Bastow*.

Var. inflata, Wilson, branches and ramules much inflated, to 3 mm., diam, cylindrical, but broader at furcations sterile.

Hab. on earth and rocks, South Esk at Launceston; and Maria Island, *Bastow*.

Var. 2, *tenera*, Wilson, sterile branches and ramules pale, filiform, intricate, procumbent, K + C —, fertile branches glaucous green, thicker, more terebrate, erect, short, and discrete. K + C +.

Hab. on logs and trunks of trees, common. Mount Wellington, etc.; Tasman Peninsula, *Weymouth*.

25. *C. retipora*, Labil., = *Cenomyce retipora*, Tayl., whitish or bluish white, cæspitose, glabrous, reticulato terebrate or lace-like, thick, branches dichotomous, short, turgid, apices obtuse. Apothecia fusco rufous, or pallescent, or nigricant.

Hab. on earth, Hook. L. J. Bot.; abundant, all collectors, Hook. Fl. Tasm.; *Stuart*, Hmpe.; Nyl.; Krplh.; Ulverstone; George Town, and Southport, and Macquarie Harbour, and Knocklofty, *Bastow*; Tasman Peninsula and Huon, *Weymouth*.

26. *C. schizopora*, Nyl., thallus of whitish or cinerascent or fuscescent squamulæ, which are often much divided or incisuso dissected or furfuraceous; podetia small, 5 to 10 mm. high, pale or fusco rufescent, glabrous, lacunose, and hiascent; much thicker upwards, and usually divided into short branches, which are all truncate and fertile. Apothecia nigricant, minute, aggregate, margined, concave when young, plane when older.

Hab. on rotten logs and trees, Nyl., ex. hb. Hook.; Ulverstone; Tasman Peninsula, *Weymouth*.

4. STEREOCAULON.

Thallus of podetia covered more or less with fragile granules of various forms. Apothecia terminal or lateral, lecideine, fuscous or fusco pallescent, internally solid. Cephalodia of various forms and colours.

1. *S. ramulosum*, Ach., thallus more or less erect, cæspitose, 3 to 5 inches high, strong, elongato ramose, the axis more or less arachnoideo tomentose, branches with whitish fibrillose granules simple or divided and divaricato ramulose. Cephalodia sub-podicellate, scrobiculato unequal, somewhat discoloured, with a gonimic stratum formed of nodules containing gonimic granules. Apothecia fuscous or pallescent, terminal, biatorine, 1 to 2 mm., broad. Spores cylindraceo fusiform, 3 to 7 septate, ·035 to ·06 × ·004 to ·006 mm.

Hab. on rocks, stones, and earth, Hook. L. J. Bot.; *Gunn and other collectors*, Hook. Fl. Tasm.; *Stuart*, Hmpe.; Krplh.; Mount Wellington, *Brown*, Cr. Prof. Mueller says Krempelhueber's specimens belong to the next species. It is probable that the others do so too.

2. *S. proximum*, Nyl., similar to *S. ramulosum*, differing in the cephalodia, in which the gonimic stratum is sirosiphoid. Spores 3 to 5 septate, ·028 to ·06 × ·004 to ·005 mm.

Hab. on rocks and earth in mountainous regions, Krplh. revis., Mull. Arg.; Mount Wellington (*Weymouth* and *Bastow*), Mount Arthur, S. Esk (Launceston), Ulverstone.

3. *S. macrocarpoides*, Nyl., podetia erect, ramulose, 1½ to 3 inches, glabrous, or for most part corticate, granules papillar,

scattered or evanescent, ramules fibrilloso divided. Cephalodia with sirosiphoid gonimic stratum. Apothecia large, 2 to 4 mm. broad, spores 3 to 7 septate, ·036 to ·058 × ·004 to ·006 mm.

Hab. on stones. Nyl. ex hb. Hook.

4. *S. coralloides*, Fr., = *S. Corallinum* of Babington, cæspitose, ramose, glabrous, granules cinerascent, sub-fibrillose, or digitato divided. Apothecia terminal and lateral. Spores cylindraceo fusiform, 3 septate, ·02 to ·04 × ·0025 to ·005 mm. Cephalodia cinerascent, verrucose, minutely granulate, sessile.

Hab. on rocks, St. Patrick's River, *Gunn*, Hook. Fl. Tasm.

5. *S. denudatum*, Flk., podetia slender, simple or branched, attenuate at apex, glabrous, granules whitish or albo cinerascent, sub-peltate, medio depressed, the centre virescent, margin white, crenulate. Apothecia fuscous, small, plane or convex, terminal or lateral, spores elongato fusiform, 3 rarely to 5 and 7 septate, ·02 to ·046 × ·002 to ·004 mm. Cephalodia olivaceo fuscescent, verrucoso glomerulose.

Hab. on rocks and stones, Cheshunt, *Archer*, Hook. Fl. Tasm.

6. *S. leptaleum*, Nyl., thallus small, 5 to 10 mm. high, erect or ascending stipate, sparingly ramose, slender, axis nude, glabrous above or granulose at apices of branches, granules few, white or whitish, sub-globose, small, or pulveraceous. Apothecia not seen. Cephalodia olivaceous, opaque, or olivaceo cinerascent, verrucoso glomerulose, or botyroideo glomerate, gonimic granules disposed in oblong or elongated nodules.

Hab. on granite stones, Nyl.; Mt. Wellington.

7. *S. gracilescens*, Nyl., white or albo cinerascent, of soft habit, with podetia nearly an inch high, cæspitoso congested and intricate, branched in the upper part, sparsely glomerulose, granulose, axis slender, filiform, somewhat glabrous, granules verruculose or nearly pulverulent. Apothecia and cephalodia not seen.

Hab. on granite rocks. St. Patrick's River, *Gunn*, Hook. Fl. Tasm.

SERIES III.—RAMALODEI.

Thallus fruticulose or filamentose, erect or pendulous, terete or variously compressed or angulose, without any folioles or granules or basal crust, internally tubulose with hollow medulla, or solid. Apothecia generally lecanorine.

GENUS I.—SIPHULA, Fr.

Thallus of terete or compressed stipes, erect, firm, simple or often dichotomously divided or ramose, apices obtuse or sub-obtuse, whitish, opaque or sub-opaque, rarely dilated or lobate, medulla white, dense, composed of elementary filaments closely arranged longitudinally. Apothecia unknown.

1. *S. torulosa,* Thunb., white, compressed, smooth, ramose, branches ascending, ramulose, torulose, often thrust down at the obtuse apices and rugose, aggregated into a bushy cushion about an inch high.

Hab. among mosses, Mount Wellington (and *Brown,* Cr.); Ben Lomond, *Bastow.*

2. *S. pteruloides,* Nyl., cæspitose, 1 to 2 inches high, whitish, opaque, upwards compressed and attenuate towards apex; often slightly canaliculate or plicatule longitudinally on both sides, dichotomous or dichotomously ramose, one branch generally the longer.

Hab. among mosses, Mount Wellington.

2. THAMNOLIA. Ach.

Thallus consisting of podetia, which are cylindrical or sub-compressed, cornute, imperforate, simple or branched, apices acute, internally fistulose. Apothecia unknown.

1. *T. vermicularis,* Sw., chalk white or whitish, 2 to 4 inches long, prostrate or ascending or erect, simple or rarely bifurcate, smooth or longitudinally rugulose, nearly dispersed, or densely stipate.

Hab. on mossy earth or among *Cladonias,* especially *C. capitellata,* in alpine places, Mount Wellington (and *Brown,* Cr.).

3. USNEA, Dill. Ach.

Thallus fruticulose, filamentose, erect or pendulous, fibrilloso ramulose, medullary axis solid. Apothecia concolorous, orbicular or peltate, terminal or lateral. Spores small, ellipsoid, colourless, simple.

1. *U. barbata,* L. Fr., albido glaucescent or pale cinereo virescent, terete, variously branched, erect or pendulous. Apothecia concolorous, rather large, fibrilloso radiate.

Hab. on trees, logs, and old rails nearly everywhere; Hook. L. J. Bot. and Fl. Tasm.; Krplh.; Wilson; *Bastow.*

F. 1. *florida,* L. Fr., erect, scabrid, divergenti ramose. Apothecia large, plane, pallido carneous, pruinose, with long ciliæ on the margin.

Hab. on trees and rails, common. Hab. Hook. L. J. Bot.; *Stuart,* Hmpe; Wilson.

F. 2, *scabrida,* Tayl. (Müll. Arg.) = *U. scabrida* of Taylor, short, branches few but covered with long fibrils. Apothecia large, disk glaucous or sub-cæsio albid, receptacle more or less ciliate. Spores broadly ellipsoid, ·01 to ·012 mm. long.

Hab. Hook. Fl. Tasm.

F. 3, *hirta*, L. Fr., erect, minutely and abundantly fibrillose, much branched, often only verrucoso sorediate.

Hab. on trees and rails; common.

F. 4, *dasypoga*, Ach. Fr., elongato pendulous, clothed with numerous short spreading fibrils.

Hab. on trees; common. St. Mary's Pass, Mount Arthur, etc.

F. 5, *dasypogoides*, Mull., Arg., pendulous, shorter and more bushy than *dasypoga*.

Hab. on trees; common. Tasman Peninsula, *Weymouth*; Wilson.

F. 6, *articulata*, Hudson, pendulous, elongato ramose, smooth, articulato constricted, more or less inflated.

Hab. on trees; frequent. Mount Wellington, etc.

2. *U. straminea*, Mull. Arg., B. v. M. Vic. Nat., 1887, Oct., p. 89.

3. *U. trichodea*, Ach., albido flavescent or white, glabrous, ramoso intricate, branches sparsely fibrillose, fibrils sometimes sub-secund. Apothecia concolorous, margin nude.

Hab. on trees. Springs and St. Crispin's Well, Mount Wellington, Mount Arthur. Tuckerman says:—*U. trichodea* and *U. longissima* are distinguished from the filamentous forms of *U. barbata* by their always epapillate thallus.

4. *U. longissima*, Ach., flavescent or albido cinerascent, slender, elongato pendulous or very long, terete or compressed, sub-pulveraceous on surface, with few long branches covered with long glabrous fibrils. Apothecia nearly concolorous or pallid, or very thinly glaucescenti suffused, terminal on ramules, margin fibrilloso ciliate.

Hab. on trees, Kplh. Perhaps the specimens found belong to the next species.

5. *U. angulata*, Ach., albido cinerascent, or albido flavescent or pallescent or glaucescent, pendulous, very long, elongato ramose, costato-angular, closely fibrillose, fibrils divaricate, here and there papilloso-scabrous. Apothecia albid or albido glaucescent, rather small, 2 to 3 mm. broad, margin ciliate, with slender fibrils.

Hab. on trees. *Gunn*, *Hooker*, *Lawrence*, Hook. Fl Tasm.; *Stuart*, Hmpe; St. Mary's Pass.

4. NEUROPOGON. Nees. and Flot.

Thallus erect, surface unequal, ramose, terete, with solid axis of horny texture, or hollow. Apothecia nigricant or occasionally pallid, terminal or sub-terminal.

1. *N. melaxanthus*, Ach., pallescent or flavescent or orange, often spotted or ringed with black at the base and elsewhere, especially at the apices, dichotomously ramose, apical ramules attenuate, scrobiculoso rugose or somewhat smooth, rarely papillato scabrous. Apothecia black or pallescent, large, 4 to 12 mm. broad, margin nude.

Hab. on rocks, Arthur Lakes, *Gunn*, Springs on Mount Wellington, *Hooker*, *Mossman*, Hook. Fl. Tasm.; Summit of Mount Wellington, (and *Brown*, Cr.; *Bastow*.)

5. Evernea. Ach. Nyl.

Thallus flacid, erect, or ascending, or prostrate, or pendulous, applanate or subterete, laciniose or much branched, destitute of rhizinæ, internally stuppeous. Apothecia lateral, lecanorine. Spores small, ellipsoid, colourless, simple.

1. *E. furfuracea* (?), Mann., cinerascent, dichotomously multi laciniate, upper surface isidioso furfuraceous or fibrillose, under surface canaliculate, black or cæsio nigricant. Apothecia sub-marginal, badio rufous, receptacle smooth.

Hab. on trees. Cheshunt, *Archer*, Hook. Fl. Tasm., where it is marked doubtful, as above, and a note is added that there was only one specimen, and that an aged and unsatisfactory one. It is not improbable that it was *Parmelia physodes*.

6. *Ramalina*, Ach. Fr.

Thallus whitish or pale, compressed, somewhat shining, rigescent, erect or prostrate, laciniate, alike on both sides. Apothecia scattered or marginal, concolorous. Spores colourless, oblong, 1 septate.

1 *R. calicaris*, Hffm., pale glaucous grey, or albido flavescent, rigescent, erect, dichotomously branched, laciniæ linear, compressed, elongated, attenuate at the apices, longitudinally lacunoso canaliculate, cortical layer filamentose. Medulla K —. Apothecia almost terminal, with deflexed and elongated extremities of the lacinæ, like a spur, behind them. Receptacle rugose beneath. Spores straight.

Hab. on trees. S. Esk (Launceston), *Gunn*, Hook. Fl. Tasm.

2. *R. fraxinea*, L., pale yellowish or glaucescent, pendulous, straggling, subrigescent, laciniæ compressed more or less broadly, applanato dilated, lacunose, longitudinally rugose or nervose, elongated and attenuate at the apices, cortical layer filamentose. Med. K —. Apothecia large, marginal, and superficial, brownish yellow or glaucescent, receptacle rugose or plicato rugose. Spores curved.

Hab. on trees. *Stuart*, Hmpe.

3. *R. Eckloni*, Spreng., *var.* 1, *membranacea*, Laur., pallido glaucous or pallid, membranaceous, compressed, laciniate, laciniæ attenuato linear, glabrous, striated, apices acuminate, inciso divided. Apothecia small, marginal or scattered, pallido carneous. Spores ovate or arcuate, 1 septate, ·012 × ·005 mm.

Hab. on trees. St. George's Bay, *Simson.*

Var. 2, *ovalis*, Tayl. = R. *ovalis*, Tayl., straw coloured or pallid, membranaceous, glabrous, minutely lacunose, obovate, simple, or sometimes broadly lobato divided. Apothecia small, scattered all over the upper surface.

Hab. on trees. *Gunn*, Hook. Fl. Tasm.

4. *R. brevis*, Wilson, *var. brevissima*, Wilson, glaucous or pallid, very short (3 to 10 mm. long), broadly applanate, more or less divided at the circumference. Apothecia large, scattered, elevated, disk concave, carneous, or albid, margin often inflexed. Spores oblong, slightly curved or reniform, 1 septate, ·08 to ·09 × ·004 mm.

Hab. on small branches of trees and bushes. Ulverstone; Antill Ponds, *Weymouth.*

5. *R. fastigiata*, Pers., pallid straw coloured, small, densely cæspitose, laciniæ sub-compressed, dilated and inflated upwards, smooth, lacunoso impressed, and nervoso rugose. Apothecia terminal, peltate, sessile, sub-fastigate, on very short divergent extremities of the laciniæ, receptacle plicato rugose. Spores ellipsoideo oblong, straight or curved, 1 septate, ·012 to ·017 × ·006 to ·007 mm.

Hab. on trees. Hook. L. J. Bot.

6. *R. geniculata*, Tayl. = *R. inflata*, Bab. = *R. pusilla*, Le Prev., pallid or straw coloured, cæspitose, sub-fastigiate, ramose, sub-terete or sub-compressed, smooth or obsoletely subnervose, often perforated with minute round holes, internally fistulose, branches attenuate. Apothecia pallido testaceous or glauco albid, terminal or sub-terminal, receptacle smooth or rugulose, sessile on a turgid branch or appendiculate. Spores oblong or fusiformi oblong, straight or obsoletely curved, ·009 to ·015 × ·004 to ·007 mm.

Hab. on living and decaying twigs and branches of trees and bushes, Macquarie Plains, *Oldfield*, Cheshunt, *Archer*, Recherche Bay, Lake St. Clair, and St. Patrick's River, *Gunn*, Hook. Fl. Tasm.; Krplh.; Hobart, Brown's River, Launceston; and B. v. M. Vic. Nat., 1887, and *Weymouth.*

SERIES IV. PHYLLODEI.

Thallus foliaceous, depressed, lobate, or variously laciniate or stellate, very rarely cæspitoso intricate; medulla stuppeous. Apothecia peltiform, or lecanorine, or lecideine, or gyrose.

GENUS I. NEPHROMA, Ach. p. parte.

Thallus with cortical layer continued on under surface, and there without nerves; colour above ochroleucous or pallescent, underneath paler or whitish or nigricant. Gonidial stratum containing true gonidia. Apothecia rufous or fuscescent.

1. *N. australe*, Rich., albido pallescent or stramineo pallescent, passim pallidi rufescent, 3 to 4 inches broad, smooth, lobato laciniate, margin sinuate, underneath whitish or whitish-straw colour, glabrous, smooth. Apothecia rufo-fuscescent or fuscous, rotundate or somewhat broader, 4 mm. broad. Spores fuscescent, fusiformi, oblong, ·015 to ·021 × ·006 to ·008 mm.

Hab. Cheshunt, *Archer*, Mount Wellington, *Hooker*, Hook. Fl. Tasm. Probably these specimens belong to the following species.

2. *N. antarcticum*, Jacquin, stramineous or glaucescenti stramineous, large or smaller, lobato laciniate, margin undulate or crenate, above lacunoso or foveolato impressed, underneath bullate, smooth, albid. Apothecia rufo-fuscous or rufous, reniform, broad, back of thalline receptacle rugose. Spores fuscous, oblong, ·02 to ·024 × ·006 to ·008 mm.

Hab. on bark of trees, Mount Wellington; Circular Head, *Weymouth*. Distinguished as a species by the upper surface foveolato impressed, and the lower bullate and whitish.

2. NEPHROMIUM, Nyl.

Like the preceding, but more fragile; colour lurid, glaucescent or fuscescent or rarely pallid. Gonimic stratum of granula gonima generally moniliformi concatenated.

1. *N. lævigatum*, Ach. *var. papyraceum*, Hffm., lurido fuscescent or glaucescent, thin, not large, orbicular, rotundato lobate, margin sinuato crenate, opaque, scarcely shining, beneath pale, glabrous and slightly rugulose. Apothecia fusco-rufous, margin of receptacle crenulato unequal, back of receptacle minutely depresso granulate. Spores fuscescent, fusiformi, oblong, 3 septate.

Hab. on branches of trees. St. Mary's Pass.

2. *N. cellulosum*, Ach., livido castaneous or castaneo fuscescent, diam. 4 inches, reticulato foveolate or lacunose lobate, below white or whitish pallescent, bullato unequal, glabrous. Apothecia rufous, to more than ½ inch broad, receptacular margin scarcely exceeding disk, and entire. Spores fuscescent, 3 septate, ·016 to ·019 × ·006 to ·007 mm.

Hab. on trees, Johnny's Creek, *Oldfield*, Cheshunt, *Archer*, Mount Wellington, Hook. Fl. Tasm.; Nyl.; Mount Wellington, and *Weymouth*.

3. PELTIGERA, Ach.

Thallus membranaceous, lobate, fragile, cortical layer not continuous on the under surface, and there generally nerved and rhizinose. Apothecia marginal on upper surface of thallus. Spores 8, colourless or slightly fuscescent, fusiform, 3 to 5 to 7 septate. Stratum gonidiale of granula gonima.

1. *P. canina*, L., cinerascent or cinereopallescent, opaque, more or less longitudinally lacunoso impressed, adpresso tomentellose, rotundato lobate, under surface longitudinally adpresso albo tomentose, with prominent pale anastomosing villoso tomentose nerves extending to the very margin, and clothed with tufts of pale rhizinæ. Apothecia fuscous or fusco rufous, adnate, margin nearly entire, back of receptacle uniformly tomentose, almost sub-furfuraceous. Spores 3 to 5 septate, ·066 to ·07 × ·0045 mm.

Hab. on mossy earth. *Stuart*, Hmpe.

Var. membranacea, Ach., thallus thinner, more glabrous.

Hab. Mount Wellington, *Brown*, Cr.

2. *P. spuria*, Ach. = *P. canina, var. pusilla*, Fr. of Hooker, cinereo virescent, small, digitato lobate, lobes ascending, smooth, glabrous in lower part, adpresso tomentellose upwards towards the apothecia, under surface whitish, with thick coarse spongioso tomentose nerves, and interstitial longitudinal whitish lacunæ. Apothecia fuscous or rufo fuscous, roundish, margin irregularly crenulate or denticulate, back of receptacle densely irregularly spongioso tomentose. Spores aciculari fusiform, 3 to 7 septate, ·056 to ·075 × ·0035 to ·0045 mm.

Hab. on earth. Southport, *Stuart*, Hook. Fl. Tasm.; Nyl.

3. *P. polydactyla*, Hffm., glauco pallescent or pallido fuscescent, digitato lobate, lobes ascending, glabrous and shining, smooth or obsoletely impressed, underneath with thick coarse spongioso tomentose fusco nigricant anastomosing more or less flattened nerves, and interstitial whitish lacunæ. Apothecia fuscous or fusco rufescent, longitudinal revolute margin irregularly crenulate, back of receptacle sub-verrucoso tomentose. Spores attenuato fusiform, 3 to 7 septate.

Hab. on mossy earth. *Archer*, *Laurence*, *Stuart*, *Hooker*, Hook. Fl. Tasm.; Ulverstone, St. Mary's Pass, Mount Wellington (and *Weymouth*); and Launceston, and Crag Creek, and New Town Falls, *Bastow*.

4. *P. horizontalis*, L., pale or pallido fuscescent or glauco pallescent, rotundato lobate, glabrous, smooth or slightly impressed, shining, margin sinuato crenate and slightly undulate, underneath with pale brown and fuscous black coarse flattened anastomosing or confluent nerves, and interstitial white lacunæ. Apothecia fuscous or fuscous black, rotundate or elliptical, plane, horizontal, margin irregularly crenulate,

often inflexed, back of receptacle verrucoso tomentose. Spores 6 to 8, colourless or pale fuscescent, fusiform, 3 septate, ·03 to ·042 × ·006 to ·007 mm.

Hab. on mossy rocks and trees, Cheshunt, *Archer;* Hook. Fl. Tasm.

4. HETERODEA, Nyl.

Thallus laciniate, sub-corneous and fragile when dry, the under surface tomentose, with cyphelloid spaces. Apothecia marginal, biatorine. Spores 8, simple, ellipsoid.

6. *H. Müelleri,* Hmpe. (Nyl.) = *Sticta Müelleri,* Hmp. = *S. cetrarioides,* Bab. = *Platysma Müelleri,* Nyl., flavido glaucescent, passim rufo-fuscescent, vivid green when fresh and moist, orbicular, 2 inches wide, smooth, sublacunose, rigescent, lineari laciniate, laciniæ sinuato multifid, the margin curved downwards, the apices broader, crenato incised, sub-ascending, underneath fuscous, sub-spongiose, with black marginal fibrils, and here and there cyphelloid whitish bare spaces. Apothecia carneo rufous, sub-pruinose, strictly marginal, 2 to 2½ inches wide, biatorine or cephaloid. Spores simple, fusiformi ellipsoid, ·009 to ·01 × ·0025 to ·003 mm.

Hab. on earth, Hook. Fl. Tasm.; Hmpe.; Nyl. The upper surface of the thallus, which when fresh and moist looks like a hepatica lying loose on the earth, shrinks when dry, so that the whole plant curls up, showing only the fuscous tomentose under surface, and bears some resemblance to dried sheep dung.

5. STICTINA, Nyl.

Thallus membranaceo lobate or lobato laciniate, the under surface rhizinose, and with cyphellæ, either true and urceolate or pseudo and pulverulent. Apothecia lecanorine. Spores fusiform, 1 to 3 rarely pluri-septate. Gonidial stratum of dark blue granula gonima.

A. Pseudo cyphellæ yellow.

1. *S. crocata,* L., lurido fuscescent, shining, broadly rotundato lobate, crenate, reticulato lacunose, reticulations and margins usually bearing citrine soredia, under-surface fusco nigricant, tomentose. Apothecia scattered, blackish; margins crenate, at length excluded. Spores 6 to 8, fuscescent, oblongo fusiform, 1 septate, ·02 to ·032 × ·009 to ·01 mm.

Hab. on earth, rocks, and trees. *Brown,* Cr.; Hook. L. J. Bot.; everywhere, *all collectors,* Hook. Fl. Tasm.; *Stuart,* Hmpe.; Krplh.; Mount Wellington, etc.; and *Bastow, Weymouth.*

2. *S. carpoloma,* Del., glaucescenti pallescent or flavido cinereo pallid, 3 to 5 inches wide, somewhat rigid, almost

shining, wholly lineari laciniate, laciniæ lineari lobate, lobes short, retuse at margin, upper surface scrobiculato unequal, underneath somewhat bullato unequal, pallid, or fuscescent; tomentum thin or evanescent, pseudo-cyphellæ small, citrine. Apothecia black, marginal, 1½ to 2 mm. broad, thalline margin smooth. Spores fuscous, fusiformi oblong, bilocular, ·023 to ·027 × ·009 to ·01 mm.

Hab. on trees. *Brown*, Cr.; Nyl.; Mount Wellington.

3. *S. gilva*, Thunb., dirty lurido pallescent, or lurido fuscescent, paler at circumference, 3 to 5 inches broad, rigescent, somewhat shining, laciniato lobate, laciniæ briefly lobate, often almost imbricate, above scrobiculato unequal, within medullary stratum white, underneath nigricant or dark fuscous, margin pallescent, tomentum moderate. Apothecia fuscous or black, opaque, 2 to 3 mm. wide, thalline receptacle rugoso scabrous, pallid, margin crenate, concolorous or pale brick-red. Spores as in *S. crocata*.

Hab. on stones and trees, Nyl; Launceston.

4. *S. granulata*, Bab., sordidly cinereo pallid or cinereo fuscescent, especially at circumference, dilated, rigid, thicker than *S. carpoloma*, nearly opaque, laciniato lobate or deeply laciniate, laciniæ crenate or lobato crenate, scrobiculate or scrobiculato unequal, margin and sometimes rugæ granuloso albido sorediate, underneath pallid, tomentum moderate, pseudo cyphellæ white or yellow, often large. Apothecia not seen.

Hab. on trees. Cheshunt, *Archer*, fertile, *Hooker* and *Gunn*, barren, Hook. Fl. Tasm.; Nyl.

B. Pseudo cyphellæ white.

5. *S. cinamomea*, Rich.=*S. fragillima*, Bab., glauco pallid or pale yellow, passim rufescenti fuscescent, thinly membranaceous, rigescent, fragile, smooth, or here and there obsoletely scrobiculato unequal, lineari laciniate, laciniæ pinnatifid, margin here and there minutely laciniato dissect, apex dichotomous, underneath fusco ochraceous or ochraceo pallid, especially towards margin, tomentum rhizinose, short, deficient at margin. Laciniæ underneath costate or sub-costate in the middle and especially towards centre of plant, above canaliculato impressed. Apothecia fuscous or rufescent, 1½ to 3 mm. broad, scattered or sub-marginal, thalline margin irregularly denticulato lacerate or sub-crenulate, and at length nearly evanescent. Spores fuscescent or fuscous, oblongo fusiform, 1 to 3 septate, ·024 to ·03 × ·009 to ·011 mm.

Hab. on rocks, earth, logs, and trees in shady places, Nyl.; Mount Wellington, Mount Arthur, St. Mary's Pass; Tasman Peninsula and Mount Bischoff, *Weymouth*, and Mount

Wellington, and Knocklofty, and Maria Island, and Circular Head, *Bastow*; B. v. M. Vic. Nat., Oct., 1887.

C. Cyphellæ urceolate or thelotremoid.

6. *S. fuliginosa*, Dicks., cervine or cinereo fuscescent, 2 to 4 inches broad, rigescent, either somewhat smooth or unequal, or here and there scrobiculato rugose, rather shining or nearly opaque, monophyllous, variously lobed, lobes rotundate, above frequently sprinkled with fuscous or nigricant coralloid isidia, underneath pallid, tomentum moderate, cyphellæ white or pale. Apothecia fusco rufescent, 1 mm. broad, scattered, often albido piloso ciliate at margin. Spores colourless, fusiform, 1 to 3 septate, ·027 to ·04 × ·007 to ·008 mm.

Hab. on trees and mossy rocks. Cheshunt, *Archer*, Hook. Fl. Tasm.

7. *S. sylvatica*, Huds., cervine or cinereo fuscescent, 4 to 6 inches or more, rather rigescent, nearly shining or sub-opaque, lightly scrobiculato unequal, laciniato lobate, lobes variously divided, divisions obtuse at apex, upper surface here and there lightly furfuraceous, beneath tomentose, fuscous or fuscescent, generally near margin pallescent. Apothecia as in *S. fuliginosa*, but rather larger and margin nude.

Hab. on mossy rocks and trunks of trees, *Stuart*, Hmpe.

8. *S. limbata*, Sm., glauco lurid or pale cervino fuscescent, 2 to 4 inches, scarcely rigescent, smooth or very lightly scrobiculate, unequal, scarcely shining, monophyllous, variously lobate, lobes rotundate, margin usually covered with cinerous or sordid bluish grey soredia, often with round patches of the same on the upper surface of the thallus chiefly towards the margin, underneath pallid, tomentum moderate or evanescent, cyphellæ white or whitish, moderate. Apothecia not seen.

Hab on trunks of trees and mossy rocks, Mount Wellington; Tasman Peninsula, *Bastow*. The last three species are similar and may be easily confounded.

9. *S. quercizans*, Ach., lurid, cervino pallescent or cervino fuscescent, 4 to 10 inches, thinly membranaceous, scarcely rigescent or shining, smooth, laciniato lobate, lobes variously crenato divided, margin chiefly granulato isidiose and then somewhat reflexed, undulate, underneath tomentose, fuscescent, but at margin pallid or ochraceo pallid, cyphellæ urceolate. Apothecia generally sub-marginal, fusco rufescent, 2 to 3 mm. broad, thalline margin thin, nude. Spores colourless, fusiform, 3 septate, ·03 to ·032 × ·008 to ·009 mm.

Hab. on trees and mossy rocks. Nyl.

10. *S. filicina*, Ach., pallido flavescent, or pallido cinereo flavicant, small or moderate, rigescent, or thinly membranaceous and scarcely rigescent, somewhat shining or sub-opaque, smooth, stipitate, or sub-stipitate, lobato incised, lobes beneath at least towards the base costate, margin variously sinuate, underneath ochraceo pallid, tomentum thin, or sometimes none. Apothecia rufous or badio rufous, scattered, 2 to 3 mm. broad, thalline margin pallido testaceous, entire, or sometimes very slightly crenulate. Spores colourless, fusiform, 1 to 3 septate, ·03 to ·04 × ·008 to ·009 mm.

Hab. Johnny's Creek, and Back River Gully, *Oldfield*, Cheshunt, *Archer*, Hook. Fl. Tasm.; Krplh.

Var. latifrous, Rich., larger and broader, 4 to 7 inches or more.

Hab. on trunks of trees, *Hooker*, near caves Back River, *Oldfield*, Hook. Fl. Tasm.; Krplh.

6. STICTA, Ach. pro parte.

Thallus variously lobed, or laciniato lobate. Rhizinæ simple. Gonidial stratum of yellowish green gonidia.

A. Pseudo cyphellæ yellow.

1. *S. aurata*, Ach., glaucous or testaceo rubricose, or rosy rubricose, widely expanded (to one foot), somewhat firm, opaque or scarcely shining, lobato divided, lobes sinuato incised, margins crenato undulate, generally citrino pulverulent, medullary stratum citrine, underneath fusco nigricant or fuscescent, margin beneath pale, briefly tomentose. Apothecia spadiceous black or black, largish or large, 5 to 8 mm., receptacle sub-podicellate in young apothecia, thalline margin thin, often inflexed, marginal or sub-marginal. Spores fuscescent, 3 septate, ·024 to ·028 × ·007 to ·008 mm.

Hab. on trunks of trees and mossy rocks. Cheshunt, *Archer*, St. Patrick's River, *Gunn*, Mount Wellington, *Hooker*, Hook. Fl. Tasm.; Krplh.; Wilson.

Var. rubella, Tayl. = *S. rubella* of Hooker, dull, lurid or pallido rubricose, widely lobate, 3 to 6 inches, firm, opaque, covered with thin white down, somewhat smooth, or obsoletely foveolato scrobiculoso unequal, here and there with punctiform citrine soredia.

Hab. Hook. L. J., Bot.; Mount Wellington, St. Mary's Pass.

2. *S. orygmæa*, Ach., flavido pallescent, or livido glauco pallescent, broadly lobate, 3 inches or more, thinly membranaceous but rigescent, slightly shining, closely scrobiculato unequal, or sometimes reticulato costate, lobes rotundate, margin broadly and unequally crenate, yellow within, underneath ochraceo pallescent, very thinly tomentose, here and

there often nearly nude. Apothecia fuscous black or black, $1\frac{1}{2}$ to 2 mm. broad, thalline receptacle smooth, margin crenulate at length almost obliterated. Spores fusiform, ·022 to ·036 × ·008 to ·01 mm.

Hab. on trees. Southport, *Stuart*, Hook. Fl. Tasm.; Hook. L. J. Bot.; Nyl.; Mount Arthur; Blue Tier, *Simson*, Tasman Peninsula, *Weymouth.*

3. *S. Urvillei*, Del., coriaceo flavescent or ochraceo pallid, widely expanded, 4 inches or more, soft, opaque, or here and there somewhat shining, smooth or passim lightly scrobiculato unequal, laciniato divided, laciniæ lobate, crenate, or variously divided, citrine within, underneath thinly tomentose, pallid, or in the centre fuscescent. Apothecia fuscous black or black, scattered, at length 3 to 5 mm. broad, thalline margin rugose. Spores fusiform, 3 to 5 septate, ·038 to ·048 × ·006 to ·007 mm.

Hab. on bushes and among mosses. B. v. M. Vic. Nat., 1887, Oct.

Var. Colensoi, Bab., firmer and scrobiculate, margins with granulose or lobulose isidia. Apothecia sometimes 7 mm. broad. Spores 1 to 3 septate, ·034 to ·04 × ·008 to ·011 mm.

Hab. in forests on bark of fagus, very abundant, *Gunn*, *Hooker*, Hook. Fl. Tasm.; Nyl.; Krplh.

B. Pseudo cyphellæ white.

4. *S. dissimulata*, Nyl., *var. multifida*, Laur., lurido glaucescent or pallido cervine or pallido lurid, of moderate size, somewhat flaccid, thin, rather shining, scrobiculato unequal, lineari laciniate, laciniæ narrow, sinuato multifid, margin often fringed with minute lobules or lacinioles, apical lobes linear, obtuse or retuse, underneath pallid or at the centre fusco pallescent, tomentum rhizinose, fuscescent or pale whitish, of moderate length, towards the margin evanescent. Apothecia fuscous, receptacle granulato rugulose, margin scarcely prominent, at length nearly excluded. Spores fuscous, oblongo fusiform, 1 or 3 septate, ·023 to ·032 × ·006 to ·008 mm.

Hab. on trunks of trees, Anna Maria River, *Brown*, Cr.

5. *S. Freycinetii*, Del., = S. *glabra*, Tayl., ochroleucous or pallid, rarely pallido rufescent, 5 to 10 inches, scarcely rigescent, slightly shining, smooth or obsoletely unequal, laciniato lobate, lobes sinuato divided, crenate, margins often partly albo sorediate, underneath slightly tomentose, fuscous or fusco cinereous, at margin pallescent or pallid. Apothecia rufous or rufo fuscescent, 2 to 4 mm. broad, receptacular margin in young state inflexed, then as if thinly lacero fimbriate or sub-crenulate, marginal or scattered. Spores colourless, oblong or oblongo fusiform, 3 septate, ·022 to ·03 × ·007 to ·009 mm.

Hab. on trees, common, Mount Wellington (and *Brown*, Cr.); everywhere, by all collectors, Hook. Fl. Tasm.; Nyl.; Krplh.; *Simson*, *Bastow*, *Weymouth*.

F. 1. *rugosa*, Nyl., thallus rugose, Nyl. Syn. Meth.

F. 2. *angusta*, Wilson, small, narrow, linear.

Hab. Mount Wellington, Blue Tier, *Simson*.

Var. 1, *fulvo cinerea*, Mont., more widely lobate, margin crenate or crenato incised, underneath ochraceo fuscescent, margin lighter, or all ochraceo pallid. Apothecia dark rufous, often larger, 3 to 5 mm. broad.

Hab. Mount Wellington.

Var. 2. *prolifera*, Mull., Arg. = *S. glabra*, Tayl., Hook. L. J. Bot.

6. *S. fossulata*, Duf. = *S. linearis*, Tayl. = *S foveolata* of Babington = *S. Billardierii*, Del. of Mull., Arg., pallid or pale lurido glaucescent or glaucescenti pallid, small or moderate or large to a foot or more, scrobiculato foveolate, and transversely costate between the pits, lineari laciniate, laciniæ subpinnatifid, intricate, apices retuse, underneath pallid or fuscescent, rhizinose tomentum moderate or scanty, or obsolete, pseudocyphellæ white or occasionally whitish-yellow, sometimes rather rare. Apothecia rufous or fusco rufous or nigricant, 2 to 3 mm. broad, marginal, plane, thalline margin at length excluded. Spores fuscous or fuscescent, oblongo fusiform, 1 to 3 septate, ·02 to ·032 × ·008 to ·011 mm.

Hab, on trees, common, Derwent River, *Brown*, Cr.; Springs on Mount Wellington, *Oldfield*, *Hooker*, Hook. Fl. Tasm.; Hook. L.J. Bot.; Nyl.; Krplh.; Mount Wellington; and Mount Dromedary, etc, *Bastow*; Blue Tier, *Simson*; Tasman Peninsula, *Weymouth*; Mount Wellington and elsewhere.

Var. 1. *cellulifera*, Tayl., thallus thick, rigid, more broadly laciniato divided and scarcely to the centre, lobes sub-palmate, profoundly reticulato scrobiculate, underneath pallid, or towards the centre dark and more reticulato rugose and thinly rhizineo tomentose.

Hab. Mount Wellington.

Var. 2. *Richardi*, Bab., glaucescent, a foot wide.

Hab. *Gunn*, Hook. Fl. Tasm.

C. cyphellæ thelotremoid.

7. *S. stipitata*, C. Kn., glauco pallid, when moist a bright green, here and there rufescent, sub-erect, 2 to 3 inches high and sometimes 4 inches broad, thin, somewhat rigid, scarcely shining, obsoletely scrobiculate, laciniato lobate, laciniæ subpinnatifid, margins sinuate and undulate, sinuses round and somewhat large, apices often broadly dilated and crenate,

sometimes deeply divided or even laciniatule, underneath pale fulvous, tomentose, tomentum short, sordid, denser towards the base, which often ends in a stout woody tomentose stipe. Apothecia fusco rufous, 1 to 3½ mm. broad, scattered, thalline margin entire, often at length obliterated. Spores colourless, fusiform, 5 septate, ·035 × ·007 mm.

Hab. on trunks of trees and fern trees and logs. Mount Wellington; Gordon River, *Allport*. The plants generally grow closely crowded together and imbricated, often covering many feet of tree or log with sub-ascending fronds. The juvenile state of this lichen is very remarkable, and, so far as I am aware, it is unique among lichens. It is about 1 inch high, fruticulose, ramose, the branches spreading out in one plane secundo incurved, the stem and lower side of the branches terete, fulvous, tomentose, the upper side plane, smooth, plumbeous, the higher branches slightly dilated, the last divisions extremely minute. The diameter of the stem is about 1 mm. The plumbeous colour is owing to the presence of numerous blue-green granula gonima disposed in a moniliform manner immediately under the upper cortex. It is notable that in the juvenile state the gonimic stratum is composed of granula gonima, while that of the adult plant is of gonidia. The adult form of the plant is developed from the apex in the shape of a minute, broad, green frond, containing true gonidia. The stem then grows thicker and more tomentose, and at length loses the plumbeous branches. Many plants wither away without developing the frond.

4. *S. damæcornis*, Ach., *var. macrophylla*, Del. = *S. macrophylla* of Hampe, pale rufescent or hepatico fuscescent, usually widely expanded, 4 to 6 inches or even a foot or more, rather rigescent and shining, smooth laciniato, lobate, laciniæ pinnatifid, apices dichotomous obtuse, underneath fusco nigricant, margin pallescent or cinereo fuscescent or ochraceo pallescent, tomentum moderate, thin, or none. Apothecia fusco rufous or fusco nigricant, 1½ to 3 mm. broad, marginal or scattered, thalline margin obsoletely crenulate or nearly entire. Spores colourless, or lightly fuscescent fusiform, 1 to 3 septate, ·026 to ·036 × ·008 to ·011 mm.

Hab. Hook. L. J. Bot.; *Stuart*, Hmpe.

Var. sub-caperata, Nyl.=*Sticta sub-caperata*, Nyl. of Cr., pale lurid, size moderate, thinner than *macrophglla* and more imbricato lobate. Spores ·026 to ·046 × ·009 to ·011 mm.

Hab. Mount Wellington, *Brown*, Cr,

5. *S. sub-variabilis*, Nyl., sub-stipitate, glaucous grey, smooth, shining, laciniato lobate, often dichotomous, terminal laciniæ linear, narrow, furcate, with rounded apices, lateral laciniæ smaller, crowded, sub-erect, beneath pale flesh pink,

tomentum short, snuff brown, margin nude. Apothecia not seen.

Hab. Mount Wellington, Mount Arthur; Gordon River, *Allport*.

6. *S. cinereo glauca*, Tayl., glaucescent or cinerascent, usually cervine at circumference, about 3 inches broad, rigescent, scarcely shining, lobate, lobes crowded, sinuate, somewhat crenate or spreading at the margin, smooth or obsoletely unequal, beneath pallid or slightly ochraceo pallid, tomentum short, concolourous, or whitish. Apothecia badio rufous, 1 to 1½ mm. broad, thalline margin slightly cremulate. Spores colourless, fusiform, 1 septate, ·036 to ·05 × ·007 mm.; attentuate at each end.

Hab. Hook. L.J. Bot.; Hmpe.; Rev. Mr. Babington compares it with *Stictina limbata*.

7. *S. prolificans*, Nyl., B. v. M. Vic. Nat., 1887, Oct.

7. Lobaria, Hffm. pro. p.

Thallus variously lobed or laciniato lobate. Rhizinæ simple. Ecyphellate, underneath bullate, reticulate tomentose. Gonidial stratum in some species formed of green gonidia, in others of dark blue granula gonima.

1. *L. scrobiculata*, Scop., glauco flavescent, reticulato scrobulate, sorediate, underneath albido bullate, tomentum fuscescent. Apothecia scattered, margin thick, entire, inflexed. Spores colourless, fusiform, 3 to 7 septate, ·05 to ·08 × ·006 to ·007 mm.

Hab. Risdon Cove, *Brown*, Cr.; Hmpe.; Hook. L.J. Bot.; *Miss Lilley*.

8. Ricasolia, D. N.

Thallus lobate or laciniate, affixed by fasciculate rhizinæ. Cyphellæ, none usually. Gonidial stratum of small green gonidia. Spermagones in mastoid prominences. Spores fusiform and septate.

1. *R. herbacea* (?), Huds., pallid or pale lurid, or here and there glauco pallescent, widely expanded, 6 inches to a foot and more, thinly membranaceous, scarcely rigescent, somewhat shining, here smooth and there rugulose, lobate, lobes crowded, rotundato crenate and undulate at margin, underneath pallid, rhizinæ concolorous or whitish. Apothecia rufous, 4 to 8 mm. broad, thalline margin entire or obsoletely and thinly crenulate, opaque, obsoletely granulato rugulose. Spores colourless, and at length often fuscescent, fusiform, often broadly fusiform, 1 septate, ·026 to ·046 × ·009 to ·012 mm.

Hab. on rocks and trunks of trees, *Gunn*, Hook. Fl. Tasm., where is is marked doubtful as above, and a note is added that there was but a single specimen, and that in bad condition.

9. Parmelia, Ach. Nyl.

Thallus lobate or laciniate, expanded, sometimes shining, medulla stuppeous. Apothecia scattered. Spores 8, ellipsoid, simple, small. Spermatia acicular, fusiformi incrassulate at the acute apices.

1. *P. perlata*, L., albo glaucescent or whitish, dilated, lobed, lobes rotundate, sub-imbricate, often albo sorediate on the margins, under surface fuscous black or black, and pale towards margin. Medulla K yellow C —. Apothecia badio rufous, margin entire. Spores ·011 to ·017 × ·007 to ·01 mm.

Hab. (various collectors) Hook. Fl. Tasm.; Hook. L. J. Bot.; Hmpe.; Krplh.; Tasman Peninsula, *Weymouth*. Often confounded with the following species, which is much more common, and is readily distinguishable by the rimulose upper surface, seen with a lens, and by the perforated apothecia, and especially by the chemical reaction.

2. *P. perforata*, Wulf., whitish or glaucous white, lobate or lobato sinuate or sinuato divided, smooth, minutely reticulato rimulose, margin often albo sorediate, under surface fuscous black or black. Medulla K yellow, then red. Apothecia badio rufescent, or fusco rufous, often medio perforate, margin entire.

Hab. Brown's River, St. Mary's Pass, Launceston, Mount Arthur; Knocklofty, *Bastow*; Circular Head, *Weymouth*.

3. *P. tenuirima*, Tayl., = *P. sulcata* of Taylor = *P. saxatilis* of Babington and Hampe, glauco cinereous or glauco pallescent or whitish, usually glaucous or virescent in growth, rigescent, somewhat shining, laciniate, laciniæ sub-pinnatifid, sinuate, concave, apices crenate and crenato divided, upper surface here and there scrobiculato impressed, and—especially towards the apices—marked with white, small rugulosities, underneath black, fibrillose. Medulla K yellow, then red. Apothecia elevated, at length appressed, incurved, rufo castaneous, or rufescent, or fusco rufous, sometimes 1 inch broad, at length splitting into lobes. Receptacle reticulato scrobiculate.

Hab. on trees and rocks, Derwent River, *Brown*, Cr.; Launceston, *Gunn*, *Hooker*, Hook. Fl. Tasm.; Hook. L. J. Bot.; Hmpe.; Nyl.; Brown's River, Mount Wellington, St. Mary's Pass, Launceston, Mount Arthur; Tasman Peninsula, *Weymouth*; Knocklofty, *Bastow*.

Var. 1, *corallina*, Mull. Arg., the white markings on the upper surface more numerous and reticulate, centre crowded with bulbous isidia.

Hab. on rocks, Launceston.

Var. 2, *multifida*, Wilson, pallid or glaucescenti pallid, laciniate, laciniæ narrow, sinuate, multifid, very laxly affixed, under surface densely hirsute. Apothecia large, over an inch wide, lacerato lobate, surface undulate, receptacle corrugate with elevated reticulations.

Hab. on Mount Arthur.

4. *P. saxatilis*, L., *var. omphalodes*, L., = *P. tenuissima*, Hmpe., fuscous or nigricant, shining, somewhat smooth, reticulato rugulose, laciniose, laciniæ sinuato multifid or sinuato incised or lobate, apices retuse, black and fibrillose beneath. Medulla K yellow, then red. Apothecia spadiceo badious or fuscous, margin entire or crenulate.

Hab. on alpine rocks, Hmpe. Query, *P. tenuirima?*

5. *P. conspersa*, Ehrh., pale ochroleucous, orbicular, laciniato divided, laciniæ appressed, contiguous or imbricate, margins sinuato incised or crenate, undulate, under surface fuscous black or fuscescent, nigro fibrillose. Medulla K yellow, then red. Apothecia spadiceous or fuscous, margin thin, inflexed. Spores ·008 to ·012 × ·005 to ·008 mm.

Hab. *Gunn*, *Hooker*, *Archer*, *Oldfield*, Hook. Fl. Tasm.; Hook. L. J. Bot.; Hmpe.; Nyl.; Krplh; Hobart, Mount Wellington, St. Mary's Pass, Launceston; and Bellerive, and Knocklofty, *Bastow*.

Var. 1, *laxa*, Mull. Arg., = *P. tasmanica*, Tayl., = *P. incisa*, Tayl., fide Mull. Arg., not appressed, imbricate, laciniæ narrow, multifid, underneath fuscous, or fuscescent, or pale, nude.

Hab. Hook. L. J. Bot.

Var. 2, *isidiata*, Anzi., centre of thallus densely isidiose.

Hab. Mount Wellington.

Var. 3, *stenophylla*, Ach., laciniæ of thallus narrower, much more divided, and imbricate.

Hab. Launceston, *Miss Lilley*.

6. *P. australiensis*, Cr., albido flavescent, opaque, beneath nigricant, nude, laciniæ long, convolute. Medulla K—C pale red. Apothecia not seen. Similar in appearance to *P. vagans*, Nyl.

Hab. on rocks, Mount Wellington, *Brown*, Cr.

7. *P. caperata*, L., flavescent or sub-stramineous, dilated, lobato incised, rugose, under surface black, margin paler, nigro

rhizinose. Thal. K f yellow C + Medulla K — C —. Apothecia badio rufescent, margin crenulate, pulverulent. Spores ·017 to ·02 × ·007 to ·01 mm.

Hab., various collectors, Hook. Fl. Tasm.; *Stuart*, Hmpe.; Krplh.; Brown's River, Hu n River, Hobart, St. Mary's Pass, Falmouth, Launceston, Ulverstone; Jordan, and Antill Ponds, and Tasman Peninsula, *Weymouth.*

8. *P. sub-caperatula*, Nyl. in lit., like a smaller *P. caperata*, thallus diminshed, adnate, lobes crenato incised, beneath black even at the extreme margin. Thal. K—C—. Apothecia pallido testaceous or testaceo rufous, 1 to 3 mm. broad, concave with receptacular margin thin, nearly entire or obsoletely crenulate. Spores 014 to ·017 × ·007 to ·008 mm.

Hab. on bark of trees, Derwent River, *Brown*, Cr.

9. *P. rutidota*, Tayl., = *P. ochroleuca*, Mull. Arg., fid. ejus, flavicant, orbicular, 3 to 4 inches wide, closely adhering, smooth, longitudinally plicate, centre minutely corrugate and tawny. Apothecia central, crowded, concave, disk rufescent, margin thin at length crenulate. Much smaller than caperata and lighter in colour.

Hab. Hook. L.J. Bot.

10. *P. tiliacea*, Ach., glaucescent, sub-orbicular, laciniato lobate, laciniæ rotundate, smooth, margin sinuato crenate. Medulla C red. Apothecia badio rufescent, chiefly in the centre of the thallus, receptacle smooth, margin nearly entire.

Hab. Cheshunt, *Archer*, Hook. Fl. Tasm.; Mount Stuart, *Weymouth*; Brown's River, Bellerive, Hobart, St. Mary's, Launceston (and *Bastow*).

Var. 1 *scortea*, Ach., orbicular, sinuato lobate, lobes short, rotund, undulate, margin inciso crenate, centre of thallus isidiiferous and pulverulent; Med. C red.

Hab. on dead wood and trees, Launceston.

Var. 2, *Hookeri*, Tayl., = *sub-lœvigata*, Nyl., fide Mull., Arg., pinnatifido divaricate, laciniæ appressed, linear, narrow, distinct, sinuato incised, apices truncato furcate, beneath very atro rhizinose; Med. C red.

Hab. on small branches of trees and bushes, Launceston; Tasman Peninsula, *Weymouth.*

11. *P. ulophylla*, Ach., orbicular, pallido virescent or cinereo virescent or pallid, glabrous, lobato laciniate, laciniæ rarely sub-rugose, apices rotundato lacerato crenate, margins elevated, crisp, and albo pulverulent, beneath sordid white, ruguloso fibrillose; Med. C red. Apothecia scattered, small fuscous, margin thin, at length rugoso crenate or pulverulent.

Hab. Brown's River, Hobart, St. Mary's Pass, Ulverstone, Mount Arthur, Launceston (and *Bastow*).

12. *P. laceratula*, Nyl., = P. *subflava* Tayl., fide Mull. Arg., whitish or albo glaucescent, thinly membranaceous, 1 to 3 inches wide, rugulose or passim smooth, lobato laciniate, margin crenate or crenato incised, or oftener for the most part lacero dissect or nearly isidioso dentate, beneath white, and with concolorous fibrils few and longish. Apothecia badio testaceous or pale badious, 2½.to 3½ mm. broad, receptacle sub-podicellate, margin thin, entire, or sub-entire. Spores ·012 to ·013 × ·007 to ·01 mm.

Hab. Hook. L. J. Bot.

13. *P. adpressa*, Krplh.; B. v. M., Vic., Nat., 1887, Oct.

14. *P. albata*, Wilson, white or bluish-white, opaque, with here and there sorediate patches, lobate or laciniato lobate, undulate, lobes rotund, crenato incised, beneath white or whitish, sometimes reddish-white, with scattered longish fibrils, concolorous, or cærulescent, or cæruleo nigricant; Med. K yellow C—. Apothecia not seen.

Hab. on rocks, Launceston.

15. *P. olivacea*, L., olivaceo fuscous, orbicular or sub-orbicular, smooth or minutely corrugated or sometimes varnished, laciniato lobate, lobes appressed, plane crenate, sub-opaque, under surface concolorous; Med. K—C—. Apothecia badious or badio rufescent, margin entire. Spores ·01 to ·019 × ·007 to ·01 mm.

Hab. on earth, rocks, and stones. Richmond, *Oldfield*, *Hooker*, Hook. Fl. Tasm.; Hobart, Launceston; Knocklofty, *Bastow*.

Var. prolixa, Ach. dark olivaceous, sub-orbicular or effuse, laciniate, laciniæ narrow, variously divided, multifid, plane, crenate, incised, under surface nigricant, fibrillose. Spores ·009 to ·012 × ·005 to ·006 mm.

Hab. Nyl. Probably subprolixa, a variety of *P. imitatrix*, Tayl.

16. *P. lanata*, L., nigricant or fusco nigricant, terete, slender, decumbent, stragglingly ramose, entangled, nearly shining. Apothecia lateral, concolorous, receptacular margin sub-entire or nearly granular, unequal. Spores ·009 to ·012 × ·007 to ·008 mm.

Hab. Mount Wellington, *Brown*, Cr. A filamentous form of *Umblicaria cylindrica*, which is found on the mountain, is very apt to be taken for this species.

17. *P. alpicola*, Th. Fr., nigro olivaceous, crustaceo cartilaginous, orbicular or expanded, sub-opaque, laciniæ convex, rugoso plicate, imbricate and complicate, narrow, toruloso intricate, apices incurved, under surface very black, sparsely fibrillose; Med. K—C—. Apothecia nigricant, concave, margin entire. Spores ·007 to ·012 × ·005 to ·009 mm.

Hab. Mount Wellington.

18. *P. physodes*, L., whitish, sub-stellate, laciniæ multifid, plane, glabrous, smooth imbricate, under surface naked, rugose, fuscous black, apices inflated and badio pallescent, Thal. K yellow, C +, Med. K — C —. Apothecia spadiceous or badio rufescent, margin entire. Spores 006 to ·008 × ·005 to ·006 mm.
Hab. Hook. L. J. Bot.; Hmpe.; Krplh.; Mount Wellington, Mount Arthur; Blue Tier, *Simson*; Tasman Peninsula, *Weymouth*; Knocklofty and Cascades, *Bastow*.

Var. 1. *vittata*, Ach., laciniæ narrow and linear, denigrate at the margin.
Hab. Brown's River, Mount Arthur.

F. lugubris, Pers.,=*P. enteromorpha*, Tayl.,=*P. physodes*, *var. enteromorpha* of Babington, generally rugulose, with narrow laciniæ spread out to a span or more.
Hab. *Brown*, Cr.; *Gunn*, *Archer*, Hook. Fl. Tasm.; Hook. L. J. Bot.; Mount Wellington.

Var. 2. *encausta*, Sw., albido cinerascent, nearly fuscescent, narrowly laciniate, unequal, laciniæ multifid, convex or terete, imbricato decumbent or depressed, under surface nigrescent, opaque. Apothecia badio rufous, margin crenulate. Spores ·007 to ·01 × ·005 to ·008 mm.
Hab. Mount Wellington.

19. *P. placorhodioides*, Nyl.,=*P. conferta*, Tayl., similar to *physodes*, but with thallus growing together as though monophyllo orbicular, thinly membranaceous, margin crenate or laciniato incised, beneath nigricant, but paler at edge or wholly albid. Apothecia much elevated, liver coloured or liver reddish, 4 to 8 mm. wide, crowded at centre of thallus. Spores ·008 to ·01 × ·005 to ·006 mm. Polymorphus, sometimes rugulose, etc., etc.
Hab., very common on trees and logs. *Oldfield*, Hook. Fl. Tasm.; Hook. L. J. Bot.; Nyl.; Huon, Brown's River, Mount Wellington, St. Mary's Pass, Launceston, Mount Arthur, Ulverstone; Tasman Peninsula, and Hobart, *Weymouth*.

20. *P. mundata*, Nyl., whitish or white, narrowly laciniate, laciniæ dichotomous, linear, 1½ to 2½ mm. broad, closely ruguloso unequal, sub-opaque, under surface black, somewhat shining, plicato corrugate, and towards apices badious or even dealbate. Apothecia pallido badious, 4 to 9 mm. broad, receptacle rugulose, elevated, base sub-podicellate, margin entire. Spores ·008 to ·009 × ·006 to ·007 mm.
Hab. on bark of trees. *Verreaux*, Nyl.; Derwent River, *Brown*, Cr.; Krplh.; Brown's River, Mount Wellington.

F. pulverata, Nyl., laciniæ somewhat broader, densely and minutely greyish-white pulverulent. Sterile.

Hab. on trees—dendrosma—in shady woods at base of Mount Wellington, *Brown*, Cr.

21. *P. pertusa*, Schrank, = *P. diatrypa*, Tayl., whitish, orbicular, plano appressed, glabrous, laciniæ narrow, multifid, sinuate, convex, somewhat shining, minutely perforated, apices dilated, crenato incised, sometimes sorediate, under surface black and rugose. Medulla K yellow C –. Apothecia rufo fuscescent, margin entire, inflexed. Spores 2 to 4, large, ·045 to ·06 × ·022 to ·028 mm.

Hab. *Brown*, Cr.; *Gunn*, Cheshunt, *Archer*, Hook. Fl. Tasm.; Brown's River, Mount Wellington, St. Mary's, St. Mary's Pass, Launceston, Mount Arthur; Blue Tier, *Simson*; Tasman Peninsula, *Weymouth* and *Bastow*.

Var. 1. *coskinodes*, Wilson, much smaller, glaucous, riddled with perforations, sometimes merely reticulate.

Hab. Mount Arthur; Tasman Peninsula, *Weymouth*.

Var. 2. *montana*, Wilson, dwarfed, generally fusco rufous or fuscous or black, laciniæ congested, convoluto undulate, perforations where usually apothecia appear, but few. Apothecia small, badio rufous or rufo fuscous, elevated, concave, margin thin, entire, back of receptacle rugose. Spores ·04 × ·025 mm.; epispore thick, like that of a pertusaria.

Hab. on twigs of shrubs at summit of Mount Wellington.

22. *P. reticulata*, Tayl., Hook. L. J. Bot. Description in Tayl. Flor. Hiber.

23. *P. angustata*, Pers., = *P. inequalis*, Tayl., = *P. moniliformis*, Bab., yellowish, sub-opaque, or rather shining, sub-orbicular, lineari laciniate, laciniæ 1 mm. wide or less, multifid, plane or convex, imbricate or sub-imbricate, often moniliformi constricted, apices attenuate, under surface either continuously or interruptedly spongy, fuliginous or fusco badious, upper surface sprinkled with minute white glandulose papillæ, visible with lens. Apothecia spadiceous, or badio fuscescent, moderate or largish, elevated and spongy at the sides, margin at length lobato unequal. Spores somewhat spherical, ·005 to ·007 × ·004 to ·005 mm.

Hab. Grass Tree Hill, *Hooker*, Cheshunt, *Archer*, Hook. Fl. Tasm.; Mount Wellington, Mount Arthur, St. Mary's Pass.

24. *P. colpodes*, Ach., whitish, sub-stellate, 1 to 2 inches wide, laciniæ 1 mm. broad, lineari multifid, rather plane, apices often 2 to 3 crenate, under surface fuligineo pannose. Apothecia spadiceo rufescent, 2 to 5 mm. wide, margin nude, entire or slightly rugulose. Spores oblong, ·0025 × ·001 mm.

Hab. Mount Wellington, Mount Arthur; Tasman Peninsula, *Weymouth*.

10. THELOSCHISTES.

Thallus laciniate, generally stellato orbicular. Apothecia orange or yellow. Spores colourless, polari bilocular.

1. *T. flavicans*, Sw., yellow or orange-yellow, cæspitose, subterete, slender, entangled, much branched, branches attenuate, furcellate at apices. Apothecia orange or rufous orange, margin thin, sub-entire. Spores elliptico oblong, ·012 to ·018 × ·007 to ·011 mm.

Hab. B. v. M., Vic. Nat., 1887, Oct.

Var. subexilis, Nyl., = *Physcia subexilis* of Crombie, smaller, cæspitose, orange-yellow throughout. Apothecia saffron orange, 1 to 2 mm. wide, thalline margin at length excluded. Spores ·011 to ·015 × ·006 to ·008 mm.

Hab. on rocks, Kent Island, *Brown* Cr.; B. v. M., Vic. Nat., 1887, Oct.

2. *T. chrysophthalmus*, L., yellow or flavo albicant, or flavo cinerascent, rigescent narrowly laciniate, laciniæ ascending, divaricato multifid, apices filbriloso ramulose or spinose, whitish beneath. Apothecia orange, margin filbriloso ciliate, sometimes naked. Spores elliptico oblong, ·011 to ·017 × ·006 to ·01 mm.

Var. Sieberi, Mull. Arg., = *Parmelia spinosa* of Taylor.

Hab. on basaltic rocks, George Town, *Gunn*, Hook, Fl., Tasm.; Hook. L. J. Bot.; Krplh.; Launceston.

3. *T. velifer*, Wilson, yellow, or in the sun orange, ½ inch or less broad, sociable, laciniolate, laciniæ somewhat convex, beneath albid, sub-canaliculate, with concolorous ciliæ, the apices ascending, elongate, applanate, inflated, with their lower cortex and the medulla usually wanting, and often exposing copious green or yellow gonidia. Apothecia orange rufous, 1 to 2 mm. broad, at length sub-cephaloid, much elevated, 1 to 2 mm. high, arising from the base of the thalline apical lobes. Spores ·01 × ·008 mm. bilocular, the locules united by medial tube.

Hab. on bark of trees and bushes, sterile. Launceston.

4. *T. parietinus*, L., yellow, sub-orbicular, membranaceous, rotundato lobate, incised, lobes sub-imbricate, appressed, plane or sub-concave, smooth, margin crenate, thickened and upturned, under surface paler or whitish. Apothecia concolorous or waxy orange, margin entire. Spores ·01 to ·016 × ·007 to ·009 mm.

Hab. on trees and rocks. *Gunn*, St. Patrick's, *Oldfield*, Cheshunt, *Archer*, Hook. Fl. Tasm.; Hmpe.; Krplh.; Brown's River, Hobart, Falmouth, Launceston, Mount Wellington; and Cornelian Bay and Bellerive, *Bastow*; Derwent River, *Weymouth*.

Var. lychnea, Ach., orange coloured, pulvinate, crowded rotundo squamulose, adscendenti imbricate, margins granuloso pulverulent or lacero dissect. Apothecia margin entire, pulverulent.
Hab. Domain, Hobart.

11. PHYSCIA, Nyl.

Thallus laciniate, usually stellato orbicular. Apothecia lecanorine, nigricant. Spores fuscous, 1 septate.

1. *P. speciosa*, Wulf., white or albo cinerascent, stellato laciniate, laciniæ narrow, multifid, plane, sub-imbricate, somewhat ascending at the apices, under surface plane, albo floculose, rhizinæ and marginal ciliæ whitish. Medulla Ky Cy. Apothecia fuscous, margin sub-entire or crenulate, incurved. Spores ·025 to ·036 × ·012 to ·017 mm.
Hab. Hmpe.; Krplh.; Mount Wellington.

F. sorediata.
Hab. Brown's River.

2. *P. comosa*, Nyl, white or albo cinerascent or albo glaucescent, laciniato divided, laciniæ rather short, ascending, ciliæ scattered and on margin, under surface pure white. Apothecia cæsio pruinose, 3 to even 13 mm. wide, elevated, receptacle podicellate, sprinkled with ciliæ, margin thin and broad. Spores ·024 to ·03 × ·012 to ·017 mm.
Hab. B. v. M., Vic. Nat., 1887, Oct.

3. *P. stellaris*, L., white or albo glaucescent, orbicular, stellari appressed, laciniæ multifid, contiguous, sub-cortically albo maculate, under surface whitish, with concolorous or fuscescent or nigricant fibrillæ. Med. K yellow C —. Apothecia fuscous black or black, naked or cæsio pruinose, margin entire or obsoletely crenulate. Spores oblong, cells nucleated, ·016 to ·024 × ·008 to ·011 mm.
Hab. on trees, St. Mary's, Launceston.

4. *P. astroidea*, Clem., greyish white, orbicular, thin, closely appressed, almost entirely granulose or leprose, laciniato effigurate at the circumference. Med. Ky Cy. Apothecia fuscous black, naked or pruinrose. Spores elliptico oblong, cells nucleated, ·017 to ·026 × ·008 to ·011 mm.
Hab. on trees, St. Mary's Pass.

5. *Physcia picta*, Sw., white or whitish, appressed, orbicular, laciniæ plane, sub-imbricate, contiguous or sub-confluent, narrow, variously crenate, under surface black, nude, opaque, but at extreme edge whitish. Apothecia black, plane, small,

1¼ mm. wide, black within, receptacle rather elevated and margin crenulate. Spores ·011 to ·02 × ·007 to 009 ·mm.

Hab. B. v. M., Vic. Nat., 1887, Oct. Very doubtful. *P. picta* is a strictly tropical and sub-tropical lichen. It has not been found in Victoria.

12. UMBLICARIA.

Thallus membranaceous, monophyllous, umblically affixed. Apothecia lecideine, complicato compound or gyrose. Paraphyses distinct. Spermatia slender, shortly cylindrical, obtuse at both apices.

1. *U. cylindrica*, L., cinerascent or dull greenish brown, thickish, unequally lobed, margins nigro fibrilloso ciliate, upper surface rugulose, under surface pallescent, more or less fibrillose. Med. K — C —. Apothecia concentrico gyrose, podicellate. Spores 8, colourless, ellipsoid, simple, ·01 to ·016 × ·006 to ·008 mm.

Hab. on sub-alpine rocks, summit Mount Wellington (and *Brown*, Cr.).

F. jubata, Wilson, black, filiform, cæspitose, elongate. entangled.

Hab. with type, Mount Wellington.

2. *U. atro-pruinosa*, Schær, *var. cinerascens*, Ach., fusco-nigricant somewhat cinerascent, smooth, or at the centre very thinly rimuloso areolate, under surface fuligineo nigricant, or, especially towards the margin, cinereous and shining. Apothecia somewhat prominent, simply lecideine, moderate. Spores simple, ellipsoid, often bean-shaped, ·011 to ·016 × ·006 to ·009 mm.

Hab. on rocks at summit of Mount Wellington. Associated with *U. cylindrica*, but on more exposed parts of the rocks.

3. *U. proboscidea*, L., cinereo nigrescent, thin, crenate, slightly lobed, pale pruinose, grey in the centre, where it is marked with elevated reticulated veins, the other portions rugose, under surface smooth, cinereo pallescent, Med. K — C red. Apothecia gyroso plicate. Spores 8, colourless, ellipsoid, simple.

Hab. Mount Wellington, *Brown*, Cr.

A LIST OF THE KNOWN LICHENS OF TASMANIA.

By John Shirley, B. Sc., Queensland.

In preparing this paper the following works have been consulted:—Babington's "Lichens of Tasmania," in Hooker's flora of the island, by a most accurate and painstaking lichenologist, many of whose names are now obsolete from changes cf classification: "Hooker's Journal of Botany for 1844 and 1847," containing descriptions of all lichens named by J. D. Hooker and T. Taylor, also the "Botany of the Antarctic Voyage of H.M. ships Erebus and Terror." Few of the names given by Hooker and Taylor are now employed, as they are mainly synonyms of lichens previously described by older collectors: the Rev. J. M. Crombie's paper on the lichens of Robert Brown's herbarium, published in the Journal of the Linnæan Society, Vol. xvii., 1879, pp. 390-401; a sound and valuable contribution: "Exotische Flechten aus dem Herbax des K. K. botanischen Hofkabinetes in Wien," and "Ein neuer Beitrag Zur Flechten Flora Australiens," by Dr. A. v. Krempelhüber, whose names, like those of Hooker and Taylor, have almost wholly lapsed: numerous "Lichenologische Beiträge," of Dr. Jean Müller, of Geneva, the most eminent lichenologist of the day; Dr. W. Nylander's "Synopsis Methodica Lichenum"; and Baron F. v. Müeller's lists of Australian lichens, in "Fragmenta Phytographiæ Australiæ," Vol. xi., and the Victorian Naturalist, Vol. iv., pp. 88-95.

The classification is that of Dr. Jean Müller, and the reference following the name of each species is the authority by which the plant is regarded as Tasmanian.

Order I.—Ephebaceæ (Nyl.) *Cromb.* (Epebacei in Grevillea. Vol. , p.).

Tribe I.—Ephebeæ (Nyl.) *Cromb.* (Ephebei in Grerellea, Vol. p.).

Genus 1.—Ephebe, *Fries.*

1. Ephebe tasmanica, *Cromb.*, Lich., R. Brown's Herb., No. 522 (b).
2. „ pubescens, *Ach.* „ „ „ „ No. 522 (a).

ORDER II.—COLLEMACEÆ, *Mull.* Arg. Enum. Lich. Genere p. 18, an Lich. Socot.

TRIBE II.—COLLEMEÆ, *Körb.*, Par. p. 408.

Genus 2.—Leptogium (Fr.), *Nyl.*

1. Leptogium tremelloides, *Fries*, Fl. Tasm., p. 353.

Genus 3.—Synechoblastus (Trer.), *Körb.*

1. Synechoblastus lencocarpus, *Mull.* Arg., s. Collema lencocarpum. *Tayl.*, Lich., R. Brown, No. 549 (b), Fl. Tasm., p. 353.
2. „ nigrescens (Trev.), *Auzi.*, s. Collema nigrescens, *Huds.*, Lich., R. Brown, No. 549 (a).
3. „ implicatus, *Mull. Arg.*, s. Collema implicatum, *Nyl.* Lich., R. Brown, No. 511.
4. „ fascicularis, *Mull. Arg.*, s. Collema aggregatum, *Nyl.*, and C. thysanæum, *Moug.*, Fl. Tas., p. 353.
5. „ flaccidus (Ach.), *Körb.*, s. C. flaccidum, *Ach.*, Fl. Tas., p. 353.

Genus 4.—Ramalodium, *Nyl.*

1. Ramalodium succulentum (R. Br.), *Nyl.*, Lich., R. Brown, No. 551.

TRIBE III.—PYRENOPSIDEÆ, *Th. M. Fries.*, Lich. Arct., p. 284.

Genus 5.—Pyrenopsis, *Nyl.*

1. Pyrenopsis tasmanica, *Nyl.*, Fl. Tasman., p. 353.

ORDER III.—LICHENACEÆ, *Mull. Arg.*, Lich. Socot., s. Eulichenes and Enum., Lich. Genère, p. 18.

TRIBE IV.—SPHÆROPHOREÆ, *Fr.*, Lich., Europ., p. 403.

Genus 6.—Sphærophoron, *Pers.*

1. Sphærophoron compressum, *Ach.*, Fl. Tasm., p. 355.
2. „ australe, *Laur.*, Lich., R. Brown, No. 517, Fl. Tas., p. 352.
3. „ coralloides, *Pers.*, Lich., R. Brown, No. 5 [illegible], Fl. Tas., p. 352.
4. „ tenerum, *Laur.*, Fl. Tasman., p. 352.

TRIBE V.—BÆONUFCEÆ, *Mull. Arg.*, Lich., Cathar., 7.

Genus 7.—Bæonufces, *Pers.*

1. Bæonufces roseus, *Pers.*, Fl. Tasman., p. 351.
2. „ heteromorphus, *Nyl.*, Fl. Tasman., p. 351.
3. „ squamarioides, *Nyl.*, s. B. splanchnirima, *Mitt.*, Knightiella lencocarpa, *Mull. Arg.*, K. squamarioides, *Mull. Arg.*, Fl. Tasman., p. 351.

TRIBE VI.—CLADOMEÆ, *Mull. Arg.*, Lich. Genère, p. 22.

Genus 8.—Stereocaulon, *Schres.*

1. Stereocaulon ramulosum, *Ach.*, Lich., R. Brown, No. 526, Fl. Tasm., p. 349, s. R. proximum, *Krph.*, Fl. Aus., 29.
„ ramulosum, v. macrocarpum, *Bab.*, Nyl., Syn. i., 236.
2. „ proximum, *Nyl.*, s. R. ramulosum, *Kremp.*, Flecht. Fl. Aus., 30.
„ proximum, v. microcarpoides, *Nyl.*, Syn. i., 238.
3. „ coralloides, *Fr.*, s. S. corallinum, *Fr.*, Fl. Tasm., p. 349.
4. „ denudatum, *Pers.*, s. S. assimile, *Nyl.*, S. mixtum, v. denudatum, *Pers.*, Fl. Tasm., p. 349.
5. „ leptaleum, *Nyl.*, Syn. i., 250.
6. „ gracilescens, *Nyl.*, Fl. Tasm., p. 349.

Genus 9.—Siphula, *Fr.*

1. Siphula torulosa, *Thunb.*, Lich., R. Brown, No. 501.

Genus 10.—Clathrina, *Mull. Arg.*

1. Clathrina retipora, *Mull. Arg.*, s. Cladonia retipora, *Flk.*, Fl. Tasm., p. 350.
2. „ aggregata, *Mull. Arg.*, s. Cladonia aggregate, *Eschw.*, Fl. Tasm., p. 350.
3. „ schizopora, *Mull. Arg.*, s. Cladonia schizopora, *Nyl.*, Syn. i., 217.

Genus 11.—Cladonia, *Hffm.*

SECTION A.—ASCYPHÆ.

1. Cladonia rangiferina, *Hffm.*, Fl. Tasm., p. 350.
„ „ v. alpestris, *L.*, s. C. sylvatica, v. sylvestris, *L.*, Kremp., Exot. Flecht., 26.
„ rangiferina, v. sylvatica, *Hffm.*, Fl. Tas., p. 350, Lich. R. Br., 527.

2. Cladonia squamosa, *Hffm.*, Fl. Tasman., p. 350, s. C. sparassa, *Ach.*, Hook. IV., 651.

„ squamosa, v. acuminata, *Ach.*, s. C. acuminata, *Ach.*, Lich. R. Br., 531.

3. „ furcata, *Hffm.*, Fl. Tasman, p. 350.

„ „ v. adspersa, *Flk.*, s. C. adspersa, *Flk.*, Lich. R. Br., 535.

„ furcata, v. asperata, *Mull. Arg.*, Lich. Beit., 381.

4. „ amaurocræa, *Sch.*, s. C. capitellata, *Bab.*, Fl. Tasm., p. 350.

5. „ ceratophylla, *Eschw.*, F. v. M., Vict. Nat., IV., 89.

SECTION B.—SCYPHOPHORÆ. Paeshcarpæ.

6. Cladonia pyxidata, *Fries.*, Fl. Tasman. p. 350.

7. „ cariosa, *Flk.*, Nyl., Syn., I., 194.

8. „ fimbriata, *Hffm.*, Fl. Tasm., p. 350.

„ „ v. adspersa, *Tuck.*, s. C. squamosa. f. cylindrica, *Kremp.*, Flecht. Flor. Aus., 17.

„ „ v. radiata, *Fr.*, Fl. Tas., p. 350, s. v. cornuta.

„ „ v. caniocrata, *Del.*, Fl. Tas., p. 350.

9. „ verticilata, *Flk.*, Fl. Tasm., p. 350.

10. „ cervicorrils, *Sch.*, Kremp. Fl. Aus., 16.

11. „ decorticata, *Fr.*, Fl. Tasm., p. 350.

12. „ degeneraus, *Flk.*, Fl. Tasm., p. 350.

SECTION C.—SCYPHOPHORÆ-ERYTHROCARPÆ.

13. „ cornucopioides, *Fr.*, s. C. deformis, v. Tasmanica, *Krph.*, Flecht., Fl. Aust., 4, Fl. Tasm., p. 351.

„ cornucopioides, v. extensa, *Sch.*, s. C. firma, *Laur*, Kremp. Ex. Fl., 36.

14. „ deformis, *Hffm.*, Lich., R. Br., No. 530, Fl. Tasm., p. 351.

15. „ digitata, *Hffm.*, Fl. Tasm., p. 351.

16. „ macilenta, *Hffm.*, Fl. Tasm. p. 351.

„ „ v. seductrix, *Nyl.*, Syn., p. 225.

17. „ floerkeana, *Fr.*, Fl. Tasm., p. 351.

TRIBE VII.—THAMNOLIEÆ, *Mull. Arg.*, Lich. Merjosh, 28.

Genus 12.—Thamnolia, *Ach.*

1. Thamnolia vermicularis, *Sch.*, Lich., R. Brown, No. 528.

TRIBE VIII.—HETERODEÆ, *Mull. Arg.*, Heterodei, *Nyl.* Fueg. Pat., p. 30.

Genus 13.--Heterodea, *Nyl.*

1. Heterodea muelleri, *Nyl.*, Syn. I., 306.

TRIBE IX.—USNEÆ *Mull. Arg.*, Bot. Socot., p. 349, and Th. M. Fries. Gen. Heterol., p. 47.

Genus 14.—Usnea, *Hffm.*

1. Usnea barbata, *Fr.*, Fl. Tas., p. 344.
   „ „ v. scabrida, *Tayl.*, Fl. Tas., p. 344.
   „ „ v. ceratina, *Sch.*, Cromb. Lich., R. Brown, No. 518 (b)
   „ „ v. florida, *Fr.* „ „ „ „ No. 518 (a)
   „ „ v. hirta, *Ach.*, *Kremp.*, Flecht. Fl. Aus., 31.
   „ „ v. tasmanica, *Mull. Arg.*, Lich. Beit., 391.
2. „ plicata, *Hffm.*, Kremp., Flecht. Exot., 62.
3. „ dasypogoides, *Nyl.*, s. U. straminea, *Mull. Arg.* Lich. Beit., 96 and 1477.
4. „ angulata, *Ach.*, Fl. Tas., p. 344.

Genus 15.—Neuropogon, *Nees et Flot.*

1. Neuropogon melaxanthus (Ach.), *Nyl.*, Lich., R. Brown, No. 523, and Fl. Tasm., p. 344.

TRIBE X.—RAMALINEÆ, *Mull. Arg.*, Bot., Socot., p. 350, and Th. M. Fries., Gen. Theterol., p. 50.

Genus 16.—Ramalina (Ach.), *Fr.*

1. Ramalina calicaris, *Fr.*, Fl. Tasman., p. 344.
2. „ pusilla, *Le Preur.*, Fl. Tasman., p. 344.
3. „ inflata, *Hook.*, v. gracilis, *Mull. Arg.*, s. R. geniculata, *Tayl.*, Flecht., Fl. Aus., 41.
4. „ Ecklonii v. ovalis, *Mull. Arg.*, s. R. calicaris B. ovalis., *Bab.*, Fl. Tas., p. 344.

Genus 17.—Evernia (Ach.), *Nyl.*

1. Evernia furfuracea, *Mann.*, Fl. Tasman., p. 344.

TRIBE XI.—PELTIGEREÆ, *Mull. Arg.*, Lich. Genère, p. 29

Genus 18.—Peltigera (Ach), *Hffm.*

1. Peltigera polydactyla, *Hffm.*, Fl. Tasm., p. 344.
   „ „ v. dolichorhiza, *Nyl.*, Kremp Flecht. Fl. Aus. 50.
2. „ horizontalis, *Hffm.*, Fl. Tasm., p. 344.

3. Peltigera rufescens, *Hffm.*, v. spuria D. c. s. P. canina, v. pusilla, *Körb.*, and P. spuria, D.C. Fl. Tas., p. 345, and Nyl. I., 325.
   „ rufescens, f. membranacea, *Ach.*, Lich., R. Brown, No. 510.

Genus 19.—Nephroma, *Nyl.*

1. Nephroma Australie, *A. Rich.*, Fl. Tasm., p. 345.

Genus 20.—Nephromium, *Nyl.*

1. Nephromium cellulosum, *Nyl.*, Lich., R. Brown, No. 543. Fl. Tas., p. 345.

TRIBE XII.—GYROPHOREÆ, *Mull. Arg.*, Lich. Genère, p. 29.

Genus 21.—Gyrophora, *Ach.*

1. Gyrophora cylindrica, *D.C.* Lich., R. Brown, No. 558.
2. „ proboscidea, *Ach.* „ „ „ „ 559.

TRIBE XIII.—PARMELIEÆ, *Mull. Arg.*, Lich. Genere, p. 31 and Lich. Parag., p. 3.

Genus 22.—Stictina, *Nyl.*

SECTION A.—CYPHELLATÆ.

1. Stictina filicina (Ach.), *Nyl.*, Fl. Tas., p. 345.
   „ „ v. latifrons, *Rich.*, s. S. latifrons, *Rich.*, Fl. Tas., p. 345.
2. „ guercizans, *Nyl.*, Syn. I., 344.
3. „ fuliginosa, *Nyl.*, Fl. Tasm., p. 346.

SECTION B.—PSEUDOCYPHELLATÆ-ALBÆ,

4. „ fragillima, *Nyl.*, v. dissecta, *Mull. Arg.*, s. S. fragillissima, *Krph.*, F. v. M., Vic. Nat., IV., 90 ; Mull. Arg., L.B. XXV., Sup.
   „ fragillima, v. dissimilis, *Nyl.*, s. S. dissimilis, *Nyl.*, and S. Cinnamomea, *Rich.*, Mull. Arg., Lich. Beit., 561.
5. „ faveolata, *Nyl.*, i., 337, Fl. Tasm., p. 346.

SECTION C.—PSEUDOCYPHELLATÆ FLAVÆ.

6. Stictina crocata, *Nyl.*, s. Sticta crocata, *L.*, Fl. Tasm., p. 345, Lich., R Br., 540.
   „ crocata, v. gilva, *Nyl.*, Syn., I., 339.

7. Stictina carpoloma (Del.), *Nyl.*, Lich., R. Brown, No. 540 (b).
„ carpoloma, v. granulata, *Nyl.*, s. S. Granulata, *Bab.*, Fl. Tas., p. 346.

Genus 23.—Sticta, *Ach.*

SECTION A.—ECYPHELLATÆ.

1. Sticta scrobiculata, *Scop.*, Lich., R. Brown, No. 541.

SECTION B.—CYPHELLATÆ.

2. Sticta damæcoruis, *Ach.*, v. subcaperata, *Nyl.*, s. S. subcaperata, *Nyl.*, Lich., R. Brown, No. 555.

SECTION C.—PSEUDOCYPHELLATÆ-ALBÆ.

3. Sticta dissimulata, *Nyl.*, v. multifida, *Laur.*, s. S. multifida, *Laur.*, Lich., R. B., 516.
4. „ fossulata, *Duf.*, Nyl., Syn., I., 363, and Lich., R. Br., No. 536.
5. „ billardieri, *Del.*, s. S. fossulata, *Krph.*, Flecht. Fl. Aus., 74, and S. Richardi, *Mut.*, *fide* Mull. Arg., Lich., Beit., 566, 1304-5, Fl. Tasm., p. 346.
6. „ polificans, *Nyl.*, F. v. M., Vic. Nat., IV., 90.
7. „ subrariabilis, *Nyl.*, F. v. M., Vic. Nat., IV., 90.
8. „ freycinetii, *Del.*, Lich., R. Brown, No. 538, Fl. Tasman., p. 346.
„ freycinetii, v. Prolifera, *Mull. Arg.*, Lich., Beit. 565, 1301.
9. „ cetrarioides, *Bab.*, Fl. Tasm., p. 346.

SECTION D.—PSEUDOCYPHELLATÆ-FLAVÆ.

10. Sticta endochrysea, *Del.*, v. Urvillei, *Mull. Arg.*, s. S. Urvillei, *Nyl.*, F. v. M., Vic. Nat., IV., 90.
„ endochrysea, v. Colensoi, *Bab.*, s. S. Colensoi, *Bab.*, Fl. Tasm., p. 345, Kremp., Flecht. Fl. Aus., 68.
11. „ orygmæa, *Ach.*, Fl. Tasman., p. 345.
12. „ aurata, *Ach.*, „ „ „
13. „ fragilis, *Mull. Arg.*, s. Endocarpon fragile, *Tayl.*, Fl. Tasman, p. 353.

Genus 24.—Ricasolia, *De Not.*

1. Ricasolia laete-vireus, *Lghtf.*, s. R. herbacea, *Nyl.*, Fl. Tas., p. 346.
„ laete-vireus, v. Sieberianus, *Mull. Arg.*, Lich., Beit., 581.

2. Ricasolia patinifera, *Mull. Arg.*, s. R. sublæris, *Nyl.*, and R. crenulata, *Kremp.*, Flecht. Flor. Aus., 76.

Genus 25.—Parmelia (Ach), *Nyl.*

SECTION A.—HYPORHIZIÆ-GLAUCESCENTES.

1. Parmelia perlata, *Ach.*, Fl. Tasm., p. 346.
2. ,, perforata, *Ach.*, s. P. reticulata, *Tayl.*, Hook. Jour. Bot, IV., 644.
,, perforata, v. ulophylla, *Meyes Flos.*, s. P. concors., *Krph.*, Flecht. Fl. Aus., 79.
3. ,, laceratula, *Nyl.*, s. P. subflara, *Tayl.*, Hook. Jour. Bot., 1847, p. 174.
4. ,, tenuirema, *Tayl.*, Lich., R. Brown, No. 537, Hook. Jour. Bot., 1844, p. 645.
5. ,, tiliacea, *Ach.*, Fl. Tasman., p. 347.
6. ,, saxatilis, *Ach.*, Fl. Tasman., p. 347.
,, ,, v. laevis, *Nyl.*, *Kremp.*, Exot. Flecht., 127.

SECTION B.—HYPORHIZÆ-FLAVESCENTES.

7. Parmelia adpressa, *Krph.*, s. P. amplexula, *Stirbon*, F. v. M., Vic. Nat., IV., 90.
8. ,, conspersa, *Ach.*, Fl. Tasman., p. 347.
,, ,, v. laxa, *Mull. Arg.*, s. P. tasmanica and P. incisa, *Tayl.*, Hook. Jour. Bot., 1844, p. 644.
9. ,, caperata, *Ach.*, Fl. Tasman., p. 347.
10, ,, subcaperatula, *Nyl.*, Lich., R. Br., No. 539.
11, ,, rutidola, *Hook. f. et Tayl.*, Hook. Jour. Bot., 1844, p. 645.

SECTION C.—OLIVACEÆ.

12. ,, prolixa, *Nyl.*, Syn., I., 396.
13. ,, olivacea, *Ach.*, Fl. Tasman., p. 347.
14. ,, lanata, *Nyl.*, Lich., R. Brown, No. 521.

SECTION D.—HYPOGYMNIÆ.

15. Parmelia australiensis, *Cromb.*, s. P. convoluta, *Krph.*, Lich., R. Br., 525 (a.)
16 ,, pertusa, *Schrank*, s. P. diatrypa, *Ach.*, Lich., R. Brown, 514 (b.), and Fl. Tasm., p. 347.

17. Parmelia physodes, *Ach.*, Fl. Tasman, p 347.
  „ physodes, v. lugubris (Pers), *Nyl.*, Lich., R. Brown, No. 526.
  „ physodes, v. sublugubris, *Mull. Arg.*, Lich. Beit., 577.
  „ physodes, v. placorhodioides, *Nyl.*, Fl. Tas., p. 347, Lich., R. Br., No. 514 (a), s. P. conflerta, *Tayl.*, Hook. Jour. Bot., 1847, p. 164.
  „ physodes, v. mundata, *Nyl.*, Lich., R. Brown, No. 515 (a).
  „ physodes, v. „ f pulverata, *Nyl.*, Lich., R. Brown, No. 550, s. P. sulphysodes, *Krph.*, Flecht. Fl. Aus., 80.
  „ physodes, v. enteromorpha, *Tuck.*, s. P. enteromorpha, *Ach.*, Hook. Jour. Bot., IV., 643.

Genus 26.—Auzia, *Mull. Arg.*

1. Auzia angustata, *Mull. Arg.*, s. Parmelia moniliformis, *Bab.*, Fl. Tas., p. 347, v. Lich., R. Brown, No. 515 (b), s. P. inequalis, *Tayl.*, Hook. Jour. Bot., 1847, p. 169.

Genus 27.—Theloschistes, *Norm.*

1. Theloschistes chrysophthalmus, *Th. Fr.*, s. Physcia chrysophthalma, *L.*, Lich., R. Brown, No. 545, Fl. Tasm., p. 348.
  „ chrysophthalmus, v. Sieberianus, *Mull. Arg.*, s. P. spinosa, *Hook. et Tayl.*, Hook. Jour. Bot. 1844, p. 644.
2. „ flavicans, *Norm.*, s. P. flavicans, *Sw.*, F. v. M., Vic. Nat., IV., 91.
3. „ parietinus, *Norm.*, s. P. parietina, *L.*, Fl. Tas., p. 348.
4. „ subescilis, *Nyl.*, s. P. subescilis, *Nyl.*, Lich., R. Br., No. 545 (b).

Genus 28.—Anaptychia, *Körb.*, Syst., p. 50.

1. Anaptychia comosa, *Trer.*, s. Physcia comosa, *Nyl.*, F. v. M., Vic. Nat., IV., 91.

Genus 29.—Physcia, *Nyl.*

1. Physcia picta, *Nyl.*, F. v. M., Vic. Nat., IV., 91.

TRIBE XIV.—PAUNARIEÆ, *Körb.*, Syst., p. 105.

Genus 30.—Pannaria, Del.

1. Pannaria rubiginoso, *Del.*, Lich., R. Brown, No. 555.
2. „ rubiginascens, *Nyl.*, Lich., R. Brown, No 512.
3. „ fulvescens, *Nyl.*, F. v. M., Vic. Nat., IV., 91.
4. „ imbricata, *Nyl.*, Fl. Tas., p. 348.

TRIBE XV.—PARMELIELLEÆ, *Mull. Arg.*, Lich., Spegaz., p. 39.

Genus 31.—Parmelliella, *Mull. Arg.*

1. Parmeliella triptophylla, *Mull. Arg.*, s. Pannaria triptophylla, *Ach.*, Fl. Tas., p. 348.
2. „ nigro-cincta, *Mull. Arg.*, s. P. nigro-cincta, *Mut.*, Fl. Tas., p. 348, Lich., R. Brown, No. 508.

TRIBE XVI.—PSOROMEÆ, *Mull. Arg.*, Lich., Spegaz., p. 39.

Genus 32.—P. Soroma (Fr.), *Nyl.*

1. Psoroma sphinctrinum, *Nyl.*, Lich., R. Brown, No. 533 (a), Fl. Tasm., p. 348.
   „ sphinctrinum, v. leprolema, *Nyl.*, Lich., R. Brown, No. 533 (b).
2. „ pholidotum, *Mull. Arg.*, s. Pannaria pholidota, *Nyl.*, P. soroma soccatum, *R. Br.*, Lich., R. Brown, No. 502.
3. „ asperellum, *Nyl.*, Lich., R. Brown, No. 547.
4. „ hypnorum (Hffm.), *Nyl.*, Lich., R. Brown, No. 554.

Genus 33.—Chondropsis, *Nyl.*

1. Chondropsis semiviridis, *Nyl.*, Lich., R. Brown, No. 525 (b).

TRIBE XVII.—PLACODIEÆ, *Mull. Arg.*, Lich. Genère, p. 37.

Genus 34.—Placodium, *Mull. Arg.*

1. Placodium rugolosum, *Nyl.*, Fl. Tasman., p. 348.
2. „ fulgeus, *D.C.* „ „ „ 349.
3. „ gelidum, *Körb.*, s. Squamaria gelida, *Linn.*, Fl. Tasm., p. 349.

Genus 35.—Amphiloma, *Fr.*

1. Amphiloma murorum, *Körb.*, F. v. M., Vict. Nat., IV., 92.

TRIBE XVIII.—PSOREÆ, *Mull. Arg.* (P. sorei, Th. M. Fries, Gen. Steterolich, p. 79), Lich., Parag., p. 8.

Genus 36.—Psora, *Mull. Arg.*

1. Psora parvifolia, *Mull. Arg.*, s. Lecisea parvifolia, *Nyl.*, F. v. M., Vic. Nat., IV., 94, Lich., R. Br., No. 552.
2. „ discipieus, *Hffm.*, s. Lec. decipieus, *Ehrb.*, Lich., R. Brown, No. 567.
3. „ crystallifera, *Mull. Arg.*, s. L. crystallifera, *Tayl.* Lich., R. Br., No. 564.

TRIBE XIX.—LECANOREÆ, *Mull. Arg.*, Bot. Socot., p. 359.

Genus 37.—Lecanora, *Ach.*

1. Lecanora (Eullcanora) subfusca, *L.*, Fl. Tasman., p. 349.
2. „ „ sordida, *Fr.*, Fl. Tasman., p. 349.
3. , „ glaucoma, *Hffm.*, Fl. Tasm., p. 349.
4. „ (Ochrolechia) pallescens, *Ach.*, Fl. Tasman., p. 349.

Genus 38.—Callopesnia, *De Not.*

1. Callopesnia cinnabarina, *Mull. Arg.*, Fl. Tasman., p. 352.

Genus 39.—Pertusaria, *D.C.*

1. Pertusia leioplaca, *Sch.*, F. v. M., Vic. Nat., IV., 93.
„ „ v. octospora, *Nyl.*, Mull. Arg., Lich., Beit., 743.
2. „ gibberosa, *Mull. Arg.*, Lich., Beit., 503.

Genus 40.—Urceolaria, *Ach.*

1. Urceolaria subocellata, *Nyl.*, Lich., R. Brown, No. 563.
2. „ scruposa, *Ach.*, s. Lecanora scruposa, Fl. Tas., p. 349.

TRIBE XX.—GYALECTEÆ, *Mull. Arg.*, Lich., Parag. p. 12.

Genus 41.—Gyalecta (Ach.), *Mull. Arg.*

1. Gyalecta cupularis, *Smmrf.*, Fl. Tasman., p. 349.

TRIBE XXI.—LECIDEÆ, *Mull. Arg.*, Lich., Genère, p. 50.

Genus 42.—Lecidea (Ach.), *Mull. Arg.*

1. Lecidea immarginata, *R. Br.*, Lich., R. Br., No. 591.
2. Lecidea flindersii, *Cromb.*, Lich., R. Brown, No. 565.
3. „ leptocarpa, *Nyl.*, Fl. Tas., p. 352.
4. „ stuartii (Hampe), *Nyl.*, Fl. Tasm., p. 352.

Genus 43.—Patellaria (Hffm.), *Mull. Arg.*

1. Patellaria grossa (Pers.), *Mull. Arg.*, s. Lec. grossa, *Pers.*, F. v. M., Vic., Nat., IV., 92.
2. „ marginiflexa, *Mull. Arg.*, s. Biatora marginiflexa, Fl. Tas., p. 352.
3. „ versicolor, *Mull. Arg.*, s. Lec. versicolor, *Fee.*, L. diachroma, *Fee.*, L. obturgesceus, *Krph.*, L. glaucesceus, *Krph.*, Lich., R. Br., No. 548.

Genus 44.—Blastenia, *Mull. Arg.*

1. Blastenia ferruginea (Huds.), *Mull. Arg.*, s. Lec. ferruginea, *Huds.*, Lich., R. Brown, No. 503.
   „ ferruginea f. crenularia, *With.*, Lich., R. Brown, No. 503.

Genus 45.—Buellia (De Not.), *Mull. Arg.*

1. Buellia atro-alba (Ach.), *Luck.*, s. Lec. atro-alba, *Ach.* Fl. Tas., p. 352
2. „ parmeliarum, *Smmrf.*, s. Abrothallus smithii *Lul.*, Fl. Tas., p 354.

Genus 46.—Rhizocarpon (Körb.), *Mull. Arg.*

1. Rhizocarpon petræum, *Körb.*, s. Lec. petræa, *Wolf.*, Fl. Tas, p. 352.
2. „ petræoides (Nyl.), *Mull. Arg.*, s. Lec. petræoides, *Bab.*, Fl. Tas., p. 352.

Genus 47.—Heterothecium (Fl.), *Mull. Arg.*

1. Heterothecium biferum, *Mull. Arg.*, s. Lec. bifera, *Nyl.* F. v. M., Vic., Nat., IV., 91.

TRIBE XXII.—BIATORINOPSIDEÆ, *Mull. Arg.*, Lich., Parag., p. 18.

Genus 48.—Biatorinopsis, *Mull. Arg.*

1. Biatorinopsis lutea, *Mull. Arg.*, s. Lec. lutea, *Dcks.*, Lich., R. Br., 529, Fl. Tasman., p. 352.

TRIBE XXIII.—COLNOGONIEÆ, *Mull. Arg.*, Lich., Parag., p. 18.

Genus 49.—Cœnogonium, *Ehrenb.*

1. Colnogonium Linkii, *Ehrenb.*, Fl. Tas., p. 353.
2. „ implescum, *Nyl.*, Lich., R. Brown, No. 504.

TRIBE XXIV.—THELOTREMEÆ, *Mull. Arg.*, Graph., Fee, pp. 3, 15.

Genus 50.—Thelotrema, *Mull. Arg.*

1. Thelotrema lepadinum, *Ach.*, Lich., R. Brown, No. 520; Fl. Tas., p. 340.

TRIBE XXV.—GRAPHIDÆ, *Mull. Arg.*, Graph., Fee, pp. 4, 13.

SUB-TRIBE 1.—ENGRAPHIDÆ, *Mull. Arg.*, Graph., Fee, pp. 4, 13.

Genus 51.—Melaspilea, *Nyl.*

1. Melaspilea circumserpens, *Nyl.*, Lich., R. Brown, No. 566.

Genus 52.—Graphis, *Ach.*

1. Graphis intricata, *Fee*, Lich., R. Brown, No. 561.

SUB-TRIBE 2.—GLYPHIDEÆ, *Mull. Arg.*, Graph., Fee, pp. 4, 61.

Genus 53.—Chiodecton, *Ach.*

1. Chiodecton perplexum, *Nyl.*, F. v. M., Vic. Nat., IV., 95.

TRIBE XXVI.—PYRENULÆ, *Mull. Arg.*, Pyr., Cub., p. 375.

SUB-TRIBE 1.—VERRUCAEÆ, *Mull. Arg.*, Pyr., Cub., pp. 376, 398.

Genus 54.—Clathroporina, *Mull. Arg.*

1. Clathroporina eminentior (Nyl.), *Mull. Arg.*, F. v. M., Vic. Nat., IV., 93.

Species, 158.
Varieties, 39.

Note.—The following may be regarded as doubtful:—

1. Cladonia gracilis, *Hffm.*, s. Cluomyce gracilis, *Ach.*, Hook. Jour. Bot., IV., 651.
   „ gracilis, v. ecmocyna, *Ach.*, f. subulata, *Ach.*, Hook. Jour. Bot., IV., 651.
2. Ramalina fastigiata, *Ach.*, Hook. Jour. Bot., IV., 654.
3. Coccocarpia plumbea (Lghtf.), *Nyl.*, s. Parmelia plumbea *Ach.*, Hook. Jour. Bot., IV., 653.